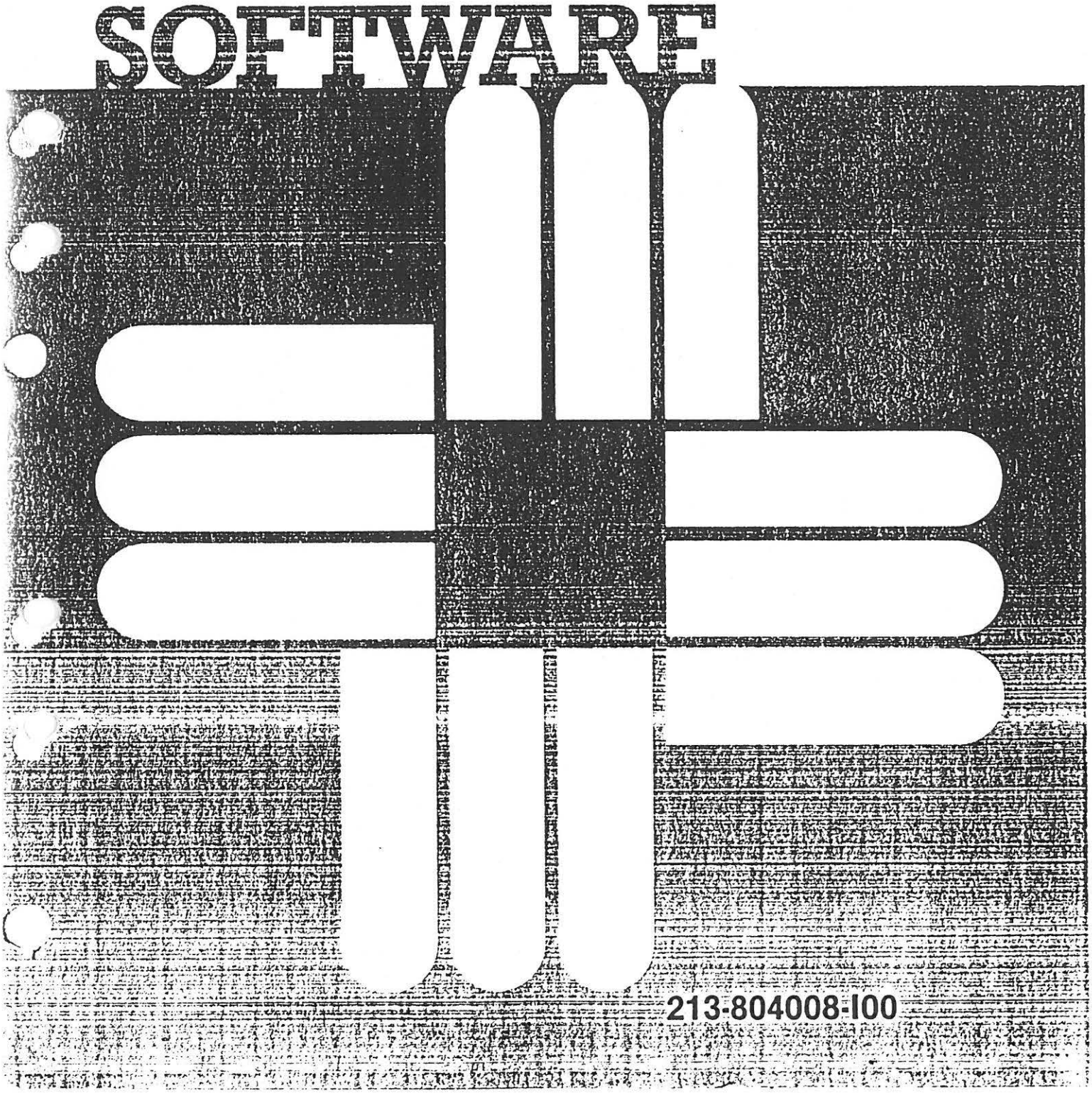
MODCOMP
MODULAR COMPUTER SYSTEMS, INC

System Guide Manual
MAX IV

Communication Handlers



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System Guide Manual
MAX IV

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Manual History

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H01	11/83	Revised to include information for MAX IV OS Revision H.1.
H02	07/84	Revision for MAX IV H.2. Corrections made to SYSGEN information for the AFD (Chapter 7).
I00	09/84	Reissue. Controller class identified for the Octal Asynchronous Interface (OAI) communications controller.

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PREFACE

Audience: The information in this manual is directed to the applications programmer or developer with a good knowledge of MODCOMP Assembler language and familiarity with MAX IV SYSGEN and REX Services.

Subject: This manual contains information about the MAX IV Communications and Process I/O Handlers. The various I/O operations and modes are described. Error/Event indicators and System Generation information are provided.

Those users familiar with previous issues of MAX IV manuals may notice that the information contained in the MAX IV INPUT/OUTPUT, Reference Manual, 210-610501-000 has been reorganized to provide easier accessibility.

The information previously contained in the chapters listed below is now available as this MAX IV COMMUNICATION HANDLERS, System Guide Manual.

Chapter 10	MAX IV BISYNC COMMUNICATION HANDLERS
Chapter 11	MAX IV ASYNCHRONOUS COMMUNICATION HANDLERS
Chapter 13	MAX IV LOCAL PROCESS I/O HANDLER
Chapter 14	MAX IV REMOTE PROCESS I/O HANDLER
Chapter 16	MAX IV SDLC/HDLC FRAME HANDLER
Chapter 17	MAX IV COMPUTER LINK/DATA TERMINAL HANDLER
Chapter 18	MAX IV STANDARD LINK FRAME LEVEL HANDLER
Chapter 20	MAX IV ASYNCHRONOUS FLOPPY DISC HANDLER FOR THE 4523 DEVICE

Products Supported: MAX IV Software System, Model 8240I.

Related Publications: The reader is referred to the manuals listed below for additional information.

Manual Order Number	Manual Title
213-804001-REV	MAX IV GENERAL OPERATING SYSTEM System Guide Manual
213-804002-REV	MAX IV SYSGEN System Guide Manual
213-804003-REV	MAX IV EXECUTIVE (REX) SERVICES System Guide Manual

213-804004-REV	MAX IV OPERATOR COMMUNICATIONS System Guide Manual
213-804005-REV	MAX IV BASIC INPUT/OUTPUT SYSTEM System Guide Manual
213-804006-REV	MAX IV UNIT RECORD DEVICE HANDLERS System Guide Manual
213-804007-REV	MAX IV DATA STORAGE DEVICE HANDLERS System Guide Manual

The following publications relate to specific chapters in this manual:

Chapter 2, MAX IV ASYNCHRONOUS COMMUNICATIONS HANDLERS

226-313001-REV	CLASSIC Communications Processor Model 3109, CRM

Chapter 3, MAX IV BISYNCHRONOUS COMMUNICATION HANDLERS

211-818001-REV	MAX IV 2780/3780 Emulator, PRM
212-818001-REV	MAX IV 2780/3780 Emulator, SDM

Chapter 4, MAX IV SDLC/HDLC FRAME HANDLER

GA27-3093-1	IBM SYNCHRONOUS DATA LINK CONTROL, General Information International Business Machines, Corporation
	Standard Network Access Protocol Specification, Trans-Canada Telephone System
ISO/TC 97/SC 6 1005	High-Level Data Link Control Procedures, International Organization for Standardization
X3S34/589	Proposed American National Standard for Advanced Data Communication Control Procedures, Fifth Draft American National Standards Institute

Chapter 5, MAX IV STANDARD LINK FRAME LEVEL HANDLER

GA27-3093-1	IBM SYNCHRONOUS DATA LINK CONTROL, General Information International Business Machines, Corporation

Chapter 6, MAX IV COMPUTER LINK/DATA TERMINAL HANDLER

225-200125-001	Model 4805-1 Data Terminal Model 4820 Computer Link, THM

Chapter 8, MAX IV LOCAL PROCESS I/O HANDLERS (Models 1300, 11xx)

211-829003-REV	MODACS III - Modular Data Acquisition and Control Subsystem Programmer's Reference Manual
211-836001-REV	MODACS II - Modular Acquisition and Control Subsystem Programmer's Reference Manual

When ordering manuals, use the Manual Order Number listed in this Preface. The latest revision (REV) will be shipped.

Special Symbols and Notations: A revision bar (|) located in the margin of the page in the text indicates a change to the manual. This change generally represents a technical change to the product due to product revision. A revision bar is also entered in the Table of Contents to flag the general location of changes in the text.

MAX IV REVISION I.Ø SUMMARY

Asynchronous Communications Handlers

Identified the controller class for the Octal Asynchronous Interface (OAI) model 4809.

Included additional information on non-standard ASCII read DMI in response to SPR.

Identified the SYSGEN LDT option for a Programmable Logic Controller (PLC).

Asynchronous Floppy Disc Handler - AF.HAN

Identified the controller class for the Octal Asynchronous Interface (OAI) model 4809.

Local Process I/O Handlers (Models 13Ø0, 11xx)

Updated information in response to SPR.

MAX IV REVISION H.Ø SUMMARY

MAX IV Asynchronous Terminal Handlers - AS.HAN, AS7.HA

TERMINAL LISTING CONTROL

Terminal Listing Control (TLC) allows the terminal user to hold or resume output to the terminal screen. This capability is selected at SYSGEN in the option parameter of the COMDEVICE statement.

TLC is supported for both full and half-duplex terminal users in either Data Interrupt (DI) or Direct Memory Interface (DMI) channel environment.

When TLC is enabled, the system recognizes default listing control characters. The LISTCONTROL SYSGEN statement may be used to define special listing control characters for the listing stop or listing resume functions. An automatic listing resume time interval may also be specified on the LISTCONTROL statement.

BUFFERED DEVICE SUPPORT

Buffered Device Support (BDS) provides interface to a buffered device in two ways. One involves RS232C signal monitoring and the other relies on input data patterns. BDS is selected at SYSGEN by setting a bit in the option parameter of the COMDEVICE statement.

Buffered Device Support is provided for both half-duplex and full-duplex modes of operation. When a buffered device indicates to stop output transmission, the associated handler will attempt to perform the function as quickly as possible.

X-ON - X/OFF character support is handled in a manner similar to that used by Terminal Listing Control. The RS232C signal support technique is primarily controlled from the hardware channel level.

MAX IV Asynchronous Handlers - AS.HAN, AS7.HA

MAX IV Bisynchronous Handlers - BI.HAN, BI7.HA, SY7.HA

MAX IV SDLC/HDLC Handlers - DLC.HA

INTERNAL WRAPROUND SUPPORT

Internal Wraparound (IW) support allows the output subchannel of a duplex channel to transmit to the input subchannel of the same duplex channel. This mode of communication is useful when diagnosing system problems or when a need exists to test out software without having to worry about the external channel line characteristics.

A privileged state is required in order to use this feature. The user task must also have exclusive use of the duplex channel pair to use this feature. Internal Wraparound is enabled or disabled by setting bits in the Extended UFT Option Word (XUFOPT) and using the REX HOME service. Only REX HOME services issued to the output channel (even numbered channel) affect IW states.

RING DETECT SUPPORT

Ring Detect Support provides the user with an auto answer mechanism that may be tailored to suit most system environments. Auto task activation (connect) and task deestablish/kill (disconnect) capabilities may be optionally selected. Hooks are available within the Terminal Monitor Program (TMP) that enable the user to perform special functions on detection of RING, BREAK, and HANG UP events.

Ring Detect Support gives the user a mechanism that allows remote connection to a MODCOMP communications line. Support includes asynchronous, byte synchronous and bit synchronous line interfaces.

The new LINEMONITOR SYSGEN statement is used to configure communication channels as either Break character/Key supported and/or Ring supported. The old BREAK SYSGEN statement will generate a SYSGEN error under MAX IV, Revision H.0. The BREAK statement's optional password argument can be specified with the new OCPASSWORD SYSGEN statement.

IMPORTANT CHANGE

AS OF MAX IV REVISION H.Ø, THE FOLLOWING USER INTERFACE CHANGES WILL TAKE EFFECT.

AS.HAN and AS7.HA - REX HOME function will no longer perform the same as REX REWIND. REX HOME is used to enable/disable Internal Wraparound.

BI.HAN, BI7.HA and SY7.HA - Previous to MAX IV, Revision H.Ø, the REX HOME service would reset DTR in the duplex channel interface. As of Revision H.Ø, the REX HOME service will have the capability of resetting DTR and performing IW features also. Concerned users should refer to Chapter 3, MAX IV BISYNCHRONOUS COMMUNICATION HANDLERS.

SL.HAN - As of MAX IV, Revision H.Ø, the REX REWIND service will be a null operation. Users are already required to be privileged.

MAX IV SDLC/HDLC Frame Handler - DLC.HA

DI ENHANCEMENT

Interrupt and Transfer (DI) and half-duplex capabilities are available in the MAX IV SDLC/HDLC Frame Handler under MAX IV, Revision H.Ø. To use the handler in DI mode, the user needs to specify class 'H' on the COMCONTROLLER SYSGEN statement for the SDLC/HDLC channel being configured. To use the handler in half-duplex mode, only one COMCONTROLLER and COMDEVICE statement should be specified for each channel pair.

MAX IV REVISION H.1 SUMMARY

The following changes have been included in the Revision H.1 release of this manual. Additional information concerning valid disc geometries for the AFD, and documentation of the COPY capability.

MAX IV REVISION H.2 SUMMARY

In revision level HØ2 of this manual, corrections were made to SYSGEN information for the Asynchronous Floppy Disc (AFD).

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CHAPTER 1
INTRODUCTION

This manual contains information about the MAX IV Input/Output handlers that communicate with the following:

- Local or remote asynchronous data terminals connected to MODCOMP communications channels
- Other computers
- SDLC/HDLC communications channels
- Devices conforming to SDLC/HDLC protocol
- A variety of custom interfaces
- A computer to computer link
- The asynchronous floppy disc device
- Process control input/output devices

1.1 HANDLER'S RESPONSE

Information about how each handler responds to the following REX Services is included:

- READ
- WRITE
- REWIND
- BKFILE
- BKRECORD
- AVRECORD
- AVFILE
- WEOF
- HOME

To use the REX services, the user's program must contain a standard User File Table and entry and return arguments associated with the REX I/O service. Non-standard devices may require additional data in the UFT.

The DEVICE and COMDEVICE SYSGEN statements create a Logical Device Table (LDT). The LDT is used by the MAX IV BIOS in servicing a REX call issued by a user program. The LDT contains the descriptive device-dependent data that is particular to a specific type of asynchronous communications terminals.

The CONTROLLER and COMCONTROLLER SYSGEN statements create the Physical Device Table (PDT). The PDT is used to provide a direct data link to the controller. The PDT contains the status and control indicators pertinent to the particular communications channel device.

Many of the handlers discussed in this manual make no distinction between the four basic modes of data transfer. A chart summarizing the handler's response to each I/O operation in each mode is presented.

After an I/O operation is performed, bits are set in the program's UFT status word (word #0) to indicate the error or event conditions that exist for the physical device to which the file is assigned. A chart indicating the meaning of each bit and the reason(s) for setting appears for each handler.

1.2 DEVICE DEPENDENT FEATURES

Device dependent options can be selected in the program's User File Table (UFT) when the program is using a particular device. These options enable/disable functions unique to certain devices. The presence of this bit in the UFT causes some devices to perform functions not general to all devices. The device dependent options that apply to each handler are described in each chapter.

Many of the handlers are designed to function with several types of devices. Some of these devices have peculiar characteristics that must be distinguished by the handler. These special functions or device characteristics are identified to the handler at SYSGEN.

1.3 HANDLER SYSGEN

The SYSGEN statements necessary to include the controller(s) and device(s) in the MAX IV system are described. If special parameters are associated with devices supported by a handler they are fully discussed in the chapter on the handler.

1.4 HOLDUP OPERATIONS

Certain situations prevent the handler from continuing operation. An example of this occurs when the physical device the handler wants to use is under exclusive use by another task. These holdup conditions are reported to the operator for resolution.

The format of the error message output to the operator is listed along with the common causes of the error.

CHAPTER 2
MAX IV ASYNCHRONOUS COMMUNICATIONS HANDLERS

These handlers are the MODCOMP software that provide a MAX IV user with the capability of communicating with local or remote asynchronous data terminals or other computers. The handlers consist of several modules that provide the means for a MODCOMP user to effectively read and/or write data to terminals connected to MODCOMP communications channels. The handler is a unit-record-oriented, logically called, asynchronous device I/O handler. It is based on the philosophy inherent in low-speed, character-oriented data terminals such as teletype or CRT.

These handlers are resident MAX IV components consisting of directly connected Service and Data Interrupt routines utilizing hardware party-line Interrupt vectors. These are permanent resident elements capable of controlling the transfer of data, status, and commands to and from an asynchronous communication data device that the MODCOMP hardware controller supports. The handler operates with Standard and Non-Standard ASCII data as well as formatted and unformatted binary data. The handler has half- and full-duplex operation capabilities in the Data Interrupt and Direct Memory Processing modes.

2.1 STANDARD CONTROLLERS SUPPORTED

There are two handlers that support asynchronous communications in MAX IV. DI-Level I/O (character interrupt) is supported through AS.HAN. This handler supports the following controller classes:

```
CLASS  MODEL NUMBER
  A = 4810,4811,4812,4813,1905(DI)
  C = 1906 DI
  D = 4804,4808,4809,4858,1907 DI,1907A DI,1907B DI,1908 DI
  I = 4806,4807
```

Direct Memory Interface I/O (DMI) is supported through AS7.HA. This handler does DMP or DMA style I/O using the MODCOMP Communications Processor (CP). The AS7.HA handler supports the following controller class:

```
CLASS  MODEL NUMBER
  F = 1907 DMI,1907A DMI,1907B DMI,1908 DMI
```

2.2 BREAK-DETECT FUNCTION

Break-detect functions are supported by the asynchronous handlers if the terminal is SYSGENed as requiring this capability. The break-detect function is supported in two ways by the handlers.

The first break-function is the break-key, on terminals so equipped. These terminals must be attached to an asynchronous controller that supports break-key interrupts. Currently, the controllers that support break in this manner are the 4804, 4806, 4807, 4808, 4809, 4858, 1907, 1907A, 1907B and 1908.

The second break-function supported is the "break character" (CONTROL "A"). The "break character" is a user-defined character that performs functionally as a break-key. To change the break character to something other than CONTROL "A" (the default), the system manager simply performs a SYSGEN using the BRKCHARACTER system block statement. If a user types this character on a half- or full-duplex terminal while the input channel is inactive or during a Non-Standard/Standard ASCII READ, the handler will perform the same function as if a break-key were depressed. The "break character" interrupt will not occur during Binary READ requests. The controller classes that support break in this manner are as follows:

```
CLASS  MODEL NUMBER
  A = 4810,4811,4812,4813,1905
  C = 1906
  D = 4804,4808,4809,4858,1907,1907A,1907B,1908(DI)
  F = 1907,1907A,1907B,1908(DMI)
  I = 4806,4807
```

For a detailed description of the LINEMONITOR and BRKCHARACTER SYSGEN macros, refer to the MAX IV SYSGEN, System Guide Manual. The user requiring break detect functions should also refer to Terminal Monitor Program, a chapter in the MAX IV GENERAL OPERATING SYSTEM, System Guide Manual. TMP monitors break supported terminals.

2.3 OPERATIONS AND MODES

An Asynchronous Communications Handler is a unit-record-oriented, logically called, interrupt driven, table controlled, communications device I/O handler. It is somewhat similar to the standard teletype handler in that it is also an extension of the MAX IV Operating System. It interfaces to the user through the standard MAX IV Basic Input/Output System. The standard calls (REX services) to the system are utilized to perform operations such as READ, WRITE, REWIND, and WRITE END-OF-FILE.

The asynchronous communications capability is based on the most common asynchronous device: a teletype or CRT type device. The handler contains half-duplex and full-duplex operational capabilities.

Unit records passed to the handler are manipulated to conform to the standards specified for a particular type of device. These operations are governed by the data content of the Logical Device Table. The handler does analyze data passed to it so that it might prefix carriage return/line feed operations to the unit being addressed. All the data is passed to the terminal with no conversions performed except to insert the proper amount of pad characters pertinent to the particular device control codes.

When the asynchronous communications channels are created during the system generation procedures, several options are available to describe the type of terminal that is to be attached to a particular communications channel. Parity may be specified in

three ways: even parity, odd parity, or no parity. The data character size of the device may be specified as five bits, six bits, seven bits, or eight bits of data. This character size specifies the actual number of bits transferred into or out of memory per character. If seven bits are specified plus parity, the high order (parity) bit is reset so that the data appears as 7-bit ASCII in the calling program's buffer. The number of stop bits may also be specified as one or two depending upon the specific characteristics of the terminal attached to a channel.

A timer may be connected to each asynchronous channel to provide for all I/O operations to be timed. The timing factor assigned for each asynchronous device is established at system generation and provides the capability to determine if a terminal is "operative."

2.4 SYSTEM INTERFACE

The Asynchronous Communications Handler interfaces with a user program through the standard MAX IV Basic Input/Output System. The user must define a User File Table within the user's program and have the appropriate data set in the table prior to issuing a REX call for any I/O operation. The MAX IV Basic I/O System takes the UFT and determines the address of the corresponding Logical Device Table. The status and control information from each table is used to initiate activity for the specific device to which I/O is to be performed by the asynchronous handler. The handler is then able to determine the Physical Device Table address that is assigned to the controller to which the particular subchannels are connected. The handler performs the indicated operation and passes the results back to the user along with the appropriate status and control indicators.

This handler is a resident MAX IV extension of the Basic Input/Output System. It consists of directly connected Service and Data Interrupt routines that utilize unique hardware party-line interrupt vectors. These are permanent resident elements that control the transfer of data to and from asynchronous communications devices.

In order to use the DMI mode, the user must supply a program module that will load the special character RAM in the Communications Processor (CP). Refer to the section on COMMUNICATIONS PROCESSOR USAGE in this chapter, for more information.

2.5 ERROR PROCESSING

The Asynchronous Communications Handler branches to the Basic I/O System error routines if the System Recovery indicator is set. If this flag is not set, control is returned to the user who must provide his/her own error routines.

2.6 STANDARD INPUT/OUTPUT FORMATS

Four basic modes of data transfer are specified by Bits 2 and 3 of the UFT option word (Word 2). These modes are summarized in Figure 2-1.

Bit 2	Bit 3	Mode	
Ø	Ø	ASCII Mode	\ Non-standard modes (for device-dependent programming)
Ø	1	Binary Mode	/
1	Ø	ASCII Mode	\ Standard MODCOMP modes (for device-independent programming)
1	1	Binary Mode	/

Figure 2-1. Standard I/O Formats

2.7 TERMINAL LISTING CONTROL

Terminal Listing Control (TLC) allows the terminal user to hold or resume terminal output asynchronously with respect to the listing. This ability is selected at SYSGEN in the option parameter of the COMDEVICE statement.

The COMDEVICE option parameter for either a half-duplex device or the output channel of a full-duplex device can enable this feature for a particular terminal. The user sets Bit 6 of the LDT option word equal to one to enable Terminal Listing Control. Before selecting optional functions, other device characteristics should be considered. System managers should refer to the description of the COMDEVICE SYSGEN statement presented in this chapter.

Terminal Listing Control is supported for both DMI and DI transfers. The channel interface must be full-duplex, however, logically the channel may be SYSGENed as either half- or full-duplex.

2.7.1 LISTING CONTROL CHARACTERS

The user controls listing output to a terminal by using the TLC characters. The user enters the Listing Stop Character to stall the listing output to the terminal. The system default Listing Stop Character is CONTROL "S". The user can continue the listing output to the terminal by entering the Listing Resume Character. The system default Listing Resume Character is CONTROL "Q".

The system manager can change the Listing Control Characters at SYSGEN. The selected characters are identified on a LISTCONTROL SYSGEN statement.

The Operator Communications directive //COM allows online changes to the characteristics of system defined communications channels. //COM can be used to dynamically change whether a terminal has the Listing Control mechanism enabled or disabled. Refer to the MAX IV OPERATOR COMMUNICATIONS, System Guide Manual.

2.7.2 AUTOMATIC LISTING RESUME

Another parameter optionally specified on the LISTCONTROL SYSGEN statement permits listings that have been held to be resumed automatically following a fixed time interval. The handler resumes output transmission following the specified time interval as if a Listing Resume Character had been received from the associated terminal input channel. Refer to the LISTCONTROL statement in the MAX IV SYSGEN, System Guide Manual.

2.7.3 TLC FUNCTIONALITY

Since a user is able to use Terminal Listing Control at any time during a terminal session, its functionality will be explained during both input and output operations.

2.7.3.1 Output Operation Active

When an output operation to the terminal is active:

- If the user enters the Listing Stop Character, the associated terminal system handler stops output to the terminal as soon as the current output operation completes.
- If the Listing Stop Character is entered when an output listing has already been held, no action occurs.
- If the user enters the Listing Resume Character, the associated terminal system handler attempts to resume output to the terminal as quickly as possible.
- If the Listing Resume Character is entered when an output listing is in progress, no change occurs.

2.7.3.2 Output Operation Not Active

When an output is not active:

- If the user enters the Listing Stop Character, the associated terminal system handler inhibits all future output to that terminal until a Listing Resume Character is received.
- If the user enters the Listing Resume Character, the associated terminal system handler allows output to occur to that terminal when output requests are received by the handler.

2.7.3.3 Standard/Non-Standard ASCII READ Active

When a Standard/Non-Standard ASCII READ is active and a TLC character is input, concurrent full-duplex output listings are affected as previously described. The Listing Control Character is not placed in the buffer associated with the current READ operation.

2.7.3.4 Standard/Non-Standard Binary READ Active

When a Standard/Non-Standard Binary READ is active and a TLC character is input, no listing control function is performed. The listing control character is placed in the buffer associated with the current READ operation.

2.7.3.5 No Input Request Active

When a user input request is not active and a TLC character is input, half- and full-duplex output listings are affected as previously described. The listing control character is discarded.

2.8 BUFFERED DEVICE SUPPORT

Buffered Device Support (BDS) is available in the MAX IV Asynchronous handlers. This feature is supported for both DMI and DI transfers. The user selects Buffered Device Support at SYSGEN by setting a bit in the option parameter of the COMDEVICE statement.

Before selecting optional functions, other device characteristics should be considered. System managers should refer to the description of the COMDEVICE SYSGEN statement presented in this chapter.

The COMDEVICE option parameter for either a half-duplex device or the output channel of a full-duplex device can enable this feature for a particular buffered device. There are two ways to interface support to a buffered device. One involves RS232C signal monitoring and the other relies on input data patterns.

Channels supporting buffered devices that use the RS232C interface technique must be SYSGENed as RS232C channels (not current loop). The user sets Bit 1 of the LDT option word equal to one to enable Buffered Device (RS232 Interface) Support for a particular channel.

Logically the channel can be SYSGENed as half-duplex or full-duplex. Physically the channel interface must be full-duplex if Buffered Device X/ON-X/OFF Support is desired. Buffered Device X/ON-X/OFF Support must be SYSGENed as Current Loop. The user sets Bit Ø of the LDT option word equal to one to enable Buffered Device (X/ON-X/OFF) Support for a particular channel.

2.8.1 WATCHDOG TIMER

The watchdog timer mechanism is not changed for this option. Buffered device output is timed for timed COMCONTROLLERS when a watchdog value is specified on the associated COMDEVICE statement. The timer value may need to be increased due to the delay possibilities of buffered devices.

2.8.2 X/ON-X/OFF SUPPORT

X/ON-X/OFF character support is handled in a manner very similar to that used by Terminal Listing Control. Buffered devices supported by the Asynchronous Communications Handlers send a "Transmission ON" (X/ON) or a "Transmission OFF" (X/OFF) character to the I/O system to signal conditions within the device. The X/OFF character (#13) indicates the device's buffer is full. Receipt of an X/OFF character during output transmission causes the output to be stopped as quickly as possible.

Interrupt mode transfers can be stopped on the very next character. Transfers under the control of the Communications Processor take additional character times.

X/OFF characters received when the output channel is non-busy cause the handler to delay further user output until an X/ON character is received.

When the buffer full condition is eliminated the device sends an X/ON character (#11). Receipt of an X/ON character while the output channel is non-busy causes the handler to allow output transmission and to continue any previously delayed listing. X/ON characters received when the output channel is busy outputting cause no change to the handler's action.

2.8.3 RS232C SUPPORT

The RS232C signal support technique is primarily controlled from the hardware channel level. Normal "controlled" output transmissions are required to wait for Clear-To-Send (CTS) and Data-Set-Ready (DSR) to be enabled before they are started. If during the transmission either DSR or CTS drops, the transfer is terminated with a malfunction error. Malfunction detection processing is modified for channels connected to buffered devices. Fluctuations in the CTS signal cause the desired stop/go output transmission affect.

The buffered device's handshaking signal line needs to be connected to the channel's CTS signal. When CTS is true, it allows output transmission to proceed. CTS dropping delays output transmission. These channels must be SYSGENed as RS232C interfaces (not Current Loop). Modems cannot be utilized on channels where Buffered Device (RS232C Signal) Support is optioned. (Therefore, buffered devices using this method cannot be used on the same line with Ring Detect Support.)

2.8.4 X/ON - X/OFF CHARACTER HANDLING

Since buffered terminals are supported, it is necessary to specify the handling of the receipt of an X/ON or X/OFF character.

- When a Standard/Non-Standard ASCII READ is active, concurrent full-duplex I/O is affected as specified in Section 2.8.2. X/ON and X/OFF characters are not placed in the buffer associated with the current READ operation.

- When a Standard/Non-Standard Binary READ is active, no change occurs to output transmission. X/ON and X/OFF characters are placed in the buffer associated with the current READ operation.

- When a user READ is not active, half- and full-duplex output transmissions are affected as described in Section 2.8.2. The X/ON and X/OFF characters are discarded.

2.8.5 BDS AND TLC SUPPORT

Table 2-1 shows the support that is available for buffered devices and devices optioned with Terminal Listing Control.

SUPPORT	DI	DMI
Terminal Listing Control (TLC) only	Terminals only	Terminals only
Buffered Device Support X/ON-X/OFF only	Terminals and Printers	Terminals and Printers
Buffered Device Support RS232C only	Terminals and Printers	Terminals and Printers
Buffered Device Support RS232C & X/ON-X/OFF Concurrently	Not Supported Defaults to no Buffered Device Support	Not Supported Defaults to no Buffered Device Support
Terminal Listing Control (TLC) & BDS X/ON-X/OFF Concurrently	Different TLC/BDS control characters needed. See SYSGEN LISTCONTROL macro.	Not Supported Defaults to BDS X/ON-X/OFF only
Terminal Listing Control (TLC) & BDS RS232C Concurrently	Terminals only	Terminals only

Table 2-1. TLC and BDS Information

2.9 RESPONSES TO OPERATIONS AND MODES

2.9.1 STANDARD ASCII READ

On Standard ASCII READ Operations each character may be returned to the terminal (ECHO) by setting the ECHO Option indicator in the Logical Device Table. This option is selected by parameter 10 of the COMDEVICE SYSGEN statement. The ECHO feature is not supported for all devices.

On a READ operation, the unit record transmitted is a line of up to 72 characters and is usually delineated by a special ASCII byte called the terminating character. Carriage widths from 4 to 510 bytes may be specified as a unit record limit for a device at system generation. For the Standard ASCII mode, the terminating character may be either a CARRIAGE RETURN (CR) or a trailing NUL (gap) character. Leading NUL characters are discarded unless the DDO bit is set in the UFT option word. Leading characters are control characters received before a valid data character is received by the handler. Trailing characters are control characters received after at least one valid data character. The control character LINE-FEED (LF) is "filtered out" on Standard ASCII operations and is never put into the user's data buffer whether leading, trailing, or intermediate.

2.9.1.1 Prefix Message

Before a READ operation is initiated to a keyboard, a short prefix consisting of a carriage return and a line feed is transmitted to the terminal. This prefix serves to:

- Inform the operator that an input is queued.
- Position the carriage on a unit record boundary (start of next line) in case it was left in an indeterminate position by the previous print or input operation.

This carriage positioning prefix may be defeated by the Device-Dependent Option bit in the UFT if the user wishes to proceed with input on the same line as a previous print operation. Of course, the program must deal with an interactive teletypewriter, in such a case, rather than with the general input device that Standard ASCII mode attempts to simulate.

To use the DMI mode for data transfer on Standard ASCII READS cell 8 in both arrays must be loaded as shown in Figure 2-2. Cell 8 in Array A consists of bytes #20-#23. In Array B, cell 8 consists of bytes #60-#63. Refer to the section on COMMUNICATIONS PROCESSOR USAGE in this chapter.

2.9.1.2 Special Purpose Characters

Error correction of operator type-in is local to the handler in this mode and requires that certain ASCII control characters be reserved for special purposes:

The BACKSPACE (CONTROL "H") is not passed as a data byte but causes the previously entered data byte and the BACKSPACE (BS) itself to be deleted from the input record. If successive BS bytes are entered, they delete an equal number of previously typed characters. If more BS bytes are entered than there are previous characters, the READ operation is terminated and restarted without any knowledge of the program.

The DELETE (DEL) byte (sometimes called RUBOUT) cancels all previously entered bytes in the input record and restarts the READ operation, also without program assistance. Thus the typist, not the program, must be concerned with this type of error.

All trailing blanks (SPACE) are suppressed and a NULL word (two NUL bytes on a word boundary) marks the end of useful information in the core buffer as long as there is still room in the buffer to store these extra bytes. A user may define such a character sequence (DFC Ø) at the end of the input buffer if the possibility exists that the input record will fill the entire buffer. This trailing blank suppression feature, though rarely necessary when the keyboard is being operated interactively, ensures that input records received from keyboard, card, and paper tape will look the same to a program.

The Standard ASCII mode is capable of detecting the presence of a Standard Binary formatted record should it encounter one. Such records are identified by a byte with a Binary value '00000011 or '00000111. These values correspond to the ASCII bytes "end-of-text" (ETX) and "bell" (BEL). These data bytes should never be used to start a Standard ASCII record. This record mode identification feature is used to permit the reading of Standard records that may be intermixed Binary and ASCII records. This is discussed in more detail in the section describing the AOn and AIn device.

After a READ operation is terminated, the first word (Bytes Ø and 1) is examined by the handler. If it contains the ASCII characters "$$", the end-of-file (EOF) indicator is turned on in the program's UFT.

A special control bit modifies the device handler's response at the end of a unit record. This bit (Bit 6 of UFT option word), when set, defeats end-of-file detection, trailing blank suppression, and the storing of the NUL byte marker at the end of useful information. In this special mode, the program can determine the exact number of bytes entered and the end of useful information in the buffer only by a byte count stored in the UFT. This mode may be used in cases where the size of the unit record is only one byte.

A character sequence:

.....LF/CR.....

is treated as a "null" or "blank" record and a NUL marker is put in Word 0 of the program's data buffer.

2.9.2 NON-STANDARD ASCII READ

A READ operation in the Non-Standard ASCII mode is not as "automatic" as the Standard ASCII mode. It requires that the user be aware that the input file is assigned to a specific type of device (that is, teletype keyboard/printer). The main purpose of the mode is to allow for device-dependent programming when the automatic editing and control character interpretation of the Standard ASCII mode are restrictive to the user's needs. This mode requires more work on the user's part, however. Such a program cannot have its file indiscriminately assigned to any input device.

This mode retains the automatic CR/LF prefix output to the printer before a READ operation is started, but this can be defeated as it could with the Standard ASCII mode. None of the local editing bytes (BS or DEL) are interpreted nor are trailing blanks suppressed or line feeds ignored. The size of variable-length unit records may be determined from the byte count returned to the UFT or by the position of a particular terminating character in the buffer.

Leading NUL characters are discarded unless the DDO bit is set in the UFT option word. The user may select a terminating byte when utilizing this mode by placing it in the UFT option word in the correct format. If the user selects not to specify a terminating byte, a leading (if not discarded) or trailing NUL character terminates the input record.

The end-of-file event is never detected in this mode, even if the first two data bytes of the unit record are '$$'.

To use the 1907, 1907A, 1907B, or 1908 in DMI mode in Non-Standard ASCII, the user must define the set of terminators the user will use and load them as illustrated in Figure 2-2. In addition, Module CM.TRT must be modified to reflect the location of the terminators in the RAM. Refer to the section on COMMUNICATIONS PROCESSOR USAGE later in this chapter.

2.9.3 STANDARD ASCII WRITE

The teletypewriter printer transmits one unit record (a line) for each WRITE operation. In the Standard ASCII mode, the text transmitted by the program must have a carriage control byte as the first byte (Byte 0) in the buffer. This byte is not printed and indicates to the handler which printer carriage positioning function is to be performed before the remainder of the buffer is printed.

Since carriage control is performed before print-out, and as an integral part of the WRITE operation, the operation frees the program from remembering from one line to the next where the carriage is positioned. The carriage control character also facilitates transmission of ultimate carriage positioning information when the printed data is diverted to secondary storage by the system (spooling) without the program's knowledge. A special task (symbiont) can use the carriage control information when it subsequently prints the diverted print data on a physical printer.

The next byte (Byte 1) following the carriage control byte may be the start of printed text. However, if this is inconvenient, text may start on the next word (Byte 2) boundary if Byte 1 is a "start-of-text" (STX) byte. This deferred text start is often convenient where WRITE operations consist of data recently received by a READ command from another device. Since the READ operation always stores data in memory starting on a word boundary, the carriage control byte and STX character can simply be put in a word that precedes the READ buffer when it is necessary to print. The print and input buffers are thus coincident (though out of phase by one word) and moving of the data is not necessary when the carriage control information is added.

```
PRBUF   DFC #2002   Print carriage control
INBUF   RES 41,0    Input buffer
```

The carriage control bytes are defined in Appendix C of the MAX IV UNIT RECORD DEVICE HANDLERS, System Guide Manual, however, the Asynchronous handlers do not support hardware carriage control.

Since USASCII is a 7-bit code, all characters transmitted to the printer have their most significant bits removed (are set to Ø) in each 8-bit byte when taken from memory. Text bytes are transmitted until a null (NUL) byte marker is found in the user's buffer or until the device's record size or the buffer's specified size is exceeded. If a NUL byte is used to terminate the output text, the NUL character is not transmitted, however, it is counted in the byte transfer count. Thus, a facility for both variable and fixed-length record sizes is provided, specified either by call argument or by the contents of the data buffer. If the user's buffer is larger than the device's record size, the additional characters are not printed. The use of the NUL byte marker is convenient as a terminator when the program generating the messages is not related to the program calling the WRITE operation. The latter can always be made to specify a buffer that is the maximum device size while the former can communicate to the handler the size of the useful text line by imbedded control bytes in the buffer.

Except for the conventions described above, all other text bytes and control bytes are transmitted to the printer. Even additional carriage control characters may be imbedded in text (e.g., CR, LF, FF) but this convention should not be used if the program might need to have its file assigned to other printing devices that may not control carriage motion with data bytes (e.g., line printer). The use of the carriage control bytes and other imbedded non-printing bytes in the buffer must be accounted for in the device

record size and buffer size. All printing devices generally have their record sizes specified two bytes larger than actual carriage width at system generation to account for carriage control bytes. A 72-column printer has 74 bytes specified; a 132 column printer has 134 bytes specified; and so on.

Non-printing terminals such as CRT's generally have their record size as the actual screen width or two characters less. Some CRT's force an automatic carriage return and line feed when the end of line is reached; therefore, if the user outputs a line feed as a part of the carriage control a double line feed will result. The user should know the characteristics of the terminal in use in order to determine this value.

Pad (NUL) characters are transmitted following line feeds (LF) and form feeds (FF) whether the handler generated the LF's and/or FF's because of carriage control logic or they were imbedded as data bytes in the user's buffer. This feature can be defeated by setting the DDO bit in the UFT option word. Pad characters are not counted as part of the transfer count.

2.9.4 NON-STANDARD ASCII WRITE

In the Non-Standard ASCII mode, no carriage control character is interpreted on WRITE operations; thus, all carriage control must be performed by imbedded control bytes in the data text buffer. Therefore, the program must know that the file is assigned to AOn before using this mode.

This mode transmits all characters in the program's data buffer until one of the following occurs:

- The device record size is exceeded
- The specified buffer size is exceeded, or
- A byte in the buffer matches the byte stored in the program's UFT option word.

Thus, variable-length records, whose size is determined by imbedded data bytes, can be transmitted in this mode also. If bit 8 of the option word is set, however, the feature is defeated and only fixed-length records can be transmitted. This mode normally terminates upon finding a NUL byte in the data buffer if the program takes no action to set the desired byte in the UFT or to defeat the feature. The terminating byte is not transmitted, however, it is counted in the byte transfer count.

Pad (NUL) characters are transmitted following line feeds (LF) and form feeds (FF) whether the handler generated the LF's and/or FF's because of carriage control logic or they were imbedded as data bytes in the user's buffer. This feature can be defeated by setting the DDO bit in the UFT option word. Pad characters are not counted as part of the transfer count.

2.9.5 BINARY DATA

Non-symbolic data is transmitted bit-for-bit from memory to device. If the target device is byte oriented, one 8-bit data byte in memory is transmitted to/from the 8-bit wide data path of the device. Two such bytes reside in each 16-bit memory location of the program's data buffer. This record format requires that Bytes 0, 2, and 3 be reserved for control purposes so that such records can be identified as binary records and so that variable-length binary records can be defined by control bytes within the unit record itself. This handler has a Standard Binary and a Non-Standard Binary mode if either format is restrictive to the program's application.

2.9.6 BINARY READ

The binary modes must be used when full 8-bit data bytes are to be transmitted from the asynchronous device. The Standard Binary mode requires a strict format for the first four bytes of the record. These 4 data bytes uniquely identify the type of record (Standard Binary) and its total length in bytes. The Non-Standard Binary mode has no strict format but unit record sizes must be known to the program since only fixed block-length records (the size of the specified data buffer) can be read.

Both modes will skip leader (NUL bytes = '00000000) on each unit record, a feature that can be defeated if Byte 0 of a Non-Standard Binary record might contain a NUL byte. In the case where NUL bytes might start a record, it is suggested that the first record (dummy, if necessary) not be allowed to begin with a NUL byte. This will allow the leader-skipping function to operate. The program can defeat the leader-skipping feature after this first record is read. All subsequent records could then contain a NUL byte as the first byte of a record. Without such a convention, the device must be accurately positioned to data Byte 0 of the first record. The leader-skipping function may be defeated by setting the DDO bit in the UFT option word.

Note that when using the 1907, 1907A, 1907B or 1908 in DMI mode, all Standard Binary Reads will be defaulted to Standard ASCII. If the user wishes to read 8-bit data the user must do so using Non-Standard Binary.

If a FILE MARK record (an ASCII record) is encountered in the Standard Binary mode, the EOF event bit is set in the program's UFT. This mechanism can be defeated by setting Bit 6 in the UFT option word. If the size of a Standard Binary record is larger than the program's buffer, the portion of the record that cannot be contained in the buffer will be skipped. This allows for record scanning where keys are being sought that reside near the beginning of a record and the entire record need not be transmitted into memory.

2.9.7 BINARY WRITE

This mode transmits 8-bit binary data bytes to the device. The Standard Binary mode requires that the data in the program's data buffer conforms to the Standard Binary record whose size in bytes must be specified in Bytes 2 and 3 of the data record. Byte 0 in the program's data buffer must be a binary record indicator byte ('00000011 or '00000111). Attempting to transmit a record that does not conform to these conventions is considered an error condition and has an associated error reason code of "IOB".

The Non-Standard Binary mode allows the program complete freedom as to the contents of the data buffer being transmitted. Only fixed block-length records may be specified and transmission will continue until either the byte count or logical record size is exceeded.

2.9.8 ADVANCE RECORD

The ADVANCE RECORD operation causes the printer carriage to be up-spaced regardless of data mode. A carriage return (CR) and a line feed (LF) byte are transmitted. No function is performed for the keyboard for this operation.

2.9.9 ADVANCE FILE

The ADVANCE FILE operation outputs a carriage return followed by four line feeds regardless of data mode. No function is performed for the keyboard for this operation.

2.9.10 REWIND

The REWIND operation outputs a form feed to the terminal regardless of data mode. The programmer is encouraged to perform this operation at the beginning of a program if the position of the carriage is unknown. This can also be accomplished by printing the first line at top-of-form. If a "spooled" device that buffers printing data to secondary storage is used, the first line must be printed at top-of-form. Printers without form-feed hardware simulate form feed by transmission of one carriage return (CR) byte followed by four line feed (LF) bytes. Bit 4 in Word 3 of the Logical Device Table (LDT) must be set at system generation if form-feed capability exists in the device. This operation initializes the file position index to zero and sets EOF and BOM in the UFT status word.

2.9.11 BACKSPACE RECORD/BACKSPACE FILE

These BACKSPACE operations do not transmit data to the terminal but act as null operations. The EOF and BOM event bits are set in the program's UFT.

2.9.12 WRITE END-OF-FILE MARK

This WRITE operation causes a "$$" message to be printed with a carriage return (CR) and two line feeds (LF) preceding it. The EOF event bit is set in the program's UFT.

2.9.13 HOME - INTERNAL WRAPAROUND

The HOME REX service is processed by the Asynchronous Communications handlers to issue Internal Wraparound (IW) requests. Requesting tasks must be privileged and should understand the ramifications of exercising internal wraparound on a duplex channel. The privileged state is required whether the user is enabling or disabling Internal Wraparound.

Only REX HOME services issued to the output channel (even numbered channel) affect IW states. The options are specified by the device dependent bits (8 through 15) of the Extended Option Word (XUFOPT) of the UFT.

Bit 10 - WRP - Enter Internal Wrap

Bit 11 - RWR - Reset Internal Wrap

Internal Wraparound (IW) support allows the output subchannel of a duplex channel to transmit to the input subchannel of the same duplex channel. While a duplex channel is in Internal Wraparound mode the following functions are disabled:

- Break key support (not available on the 481X controllers)
- Break character support
- Echoplex handling
- External transmitting of data.

IW loops transmit data back to receive data and forces a mark condition to the modem/line interface.

The user is responsible for output subchannel to input subchannel activity on a duplex channel while in IW mode. This is one reason why users are required to be privileged.

Issuing IW requests to input subchannels of duplex channels is a null operation. Meaningful IW requests must be issued to the output subchannels of duplex channels.

Internal Wraparound mode is not available on duplex channels configured within the system as half-duplex. Issuing requests with both WRP and RWR set or both WRP and RWR reset results in a null IW channel state change. IW requests for the current internal wraparound state (enable when already enabled or disable when already disabled) are null operations.

2.9.13.1 Exclusive Use

The MAX IV system is responsible for proper exiting of tasks that abort abnormally. It is, therefore, responsible for assuring that output subchannels of duplex channels in IW mode are returned to normal transfer states when a task aborts. In order that this may be accomplished, the user must take exclusive use of the output channel associated with a full-duplex pair before IW mode can be utilized. It is highly suggested that the user take exclusive use of the input channel also. Exclusive use of both channels should be given up upon completion of IW operations.

2.9.13.2 Exiting IW

Tasks using the IW enhancement are required to return communications lines to normal transfer states upon gracefully exiting the system. Since the tasks using this mechanism are privileged, they are responsible for such an action. However, the system forces all devices under exclusive use by a task to be automatically given up when a task exits the system. When exclusive use is given up on an output subchannel that is in IW mode, Internal Wraparound is automatically disabled as if the user had issued a HOME Request to exit Internal Wraparound Mode.

2.9.14 HOME - LINE DISCONNECT

A line disconnection may be forced by issuing a REX HOME service to the half/full-duplex channel. The request may be issued to either channel when a full-duplex line is being disconnected. The option is defined by the device dependent bits (8 through 15) of the extended option word (XUFOPT) of the UFT as follows:

Bit 12 - DCL - Disconnect Line

The function performed by the handler will be the same as if the handler had detected an actual line disconnection except that Line Disconnect Delay Support, if optioned, is not performed. (Refer to the RING DETECT SUPPORT section of this chapter for more information.)

2.9.15 SUMMARY TABLES

Asynchronous Handlers summary tables appear at the end of this chapter. Table 2-4 contains information about the handler's response to I/O operations in four modes of data transfer. Table 2-5 lists the error and event bits in the UFT status word (UFTSTA). Conditions causing the error or event are also listed.

2.10 RING DETECT SUPPORT

Ring Detect Support provides a useful interface to auto-answer modems. Ring Detect is supported by AS.HAN on 4804, 4808 and 4809 controllers and by both AS.HAN and AS7.HA on 1907, 1907A, 1907B, and 1908 controllers.

When ring is detected, Data Terminal Ready is enabled if not enabled already. Break Support will be initialized on asynchronous lines where optioned. Finally, the outside world is notified of the event by enqueuing a packet (containing line connect event information) to TMP (or other line monitoring task). If a line disconnection occurs, Data Terminal Ready and Break are disabled.

2.10.1 LINE DISCONNECTION

A line disconnection sequence is executed for the following conditions:

- An output channel hardware malfunction occurs during a WRITE operation. (NOTE: Buffered Device Support handles this differently.)
- An input channel hardware malfunction occurs during a READ operation.
- DSR drops while either the input or output channel are inactive.

The above conditions are expected to handle most line disconnections. Due to the unique nature of select modems, a small percentage of disconnections will go unnoticed. However, an intelligent task may be able to determine that a line has been disconnected due to its unique communication protocol, for example, a LOGOFF in a TSX environment. In these cases, the task may issue a software requested line disconnection (refer to the REX HOME Service).

2.10.2 AUTO TASK LINE CONNECT/DISCONNECT

Auto Task Line Connect Support (LINEMONITOR option CONN) and Auto Task Line Disconnect Support (LINEMONITOR option DISC) cause the system supplied line monitor task (TMP) to perform one additional function (other than the required functions to setup support) as defined below:

- Auto Task Line Connect Support causes TMP to Establish and Activate the current attentive task.
- Auto Task Line Disconnect Support causes TMP to Deestablish and Kill the current attentive task.

Both of these options require that Ring Support (RING) also be optioned.

2.10.3 LINE DISCONNECT DELAY

Line Disconnect Delay Support (LINEMONITOR option DELAY) forces a delay between the time a line disconnect is detected and the handlers normal action associated with such an event is executed. When the delay interval expires, the handler will discard the event if a line connect has since occurred. This support requires that Ring Support (RING) also be optioned.

LINE CONDITION EVENT	LINE MONITOR OPTIONS			ACTION
	ON	OFF	DO NOT CARE	
RING	RING	CONN	BREAK DISC	1. Call User Hook Routine (U$COMM) 2. Continue/Bypass normal function
RING	RING CONN		BREAK DISC	1. Call User Hook Routine (U$COMM) 2. Activate the attentive task 3. Continue/Bypass normal function
RING		RING CONN	BREAK DISC	No Action
HANG	RING	DISC	BREAK CONN	1. Call User Hook Routine (U$COMM) 2. Continue/Bypass normal function
HANG	RING DISC		BREAK CONN	1. Call User Hook Routine (U$COMM) 2. Deestablish/Kill attentive task 3. Continue/Bypass normal function
BREAK	BREAK		RING DISC CONN	1. Call User Hook Routine (U$COMM) 2. Continue/Bypass normal function

Table 2-2. Control Ring Events

Table 2-2 shows how Ring Detect Support allows the user to tailor the communications environment to suit his/her unique needs and how the user gains control over each ring event that occurs. (Refer to the TMP Chapter for information concerning the use of the U$COMM User Hook in the MAX IV GENERAL OPERATING SYSTEM, System Guide Manual.)

2.11 COMMUNICATIONS PROCESSOR USAGE

The Communications Processor (CP) allows for an asynchronous direct memory inter face (DMI), can be used in conjunction with the following communication controllers:

1907, 1907A, 1907B, and 1908.

Asynchronous direct memory interface transfers require the system manager to be aware of certain additional considerations.

The Communications Processor uses a special character array RAM that must be loaded prior to using the direct memory interface. The Communications Processor utilizes this array in order to detect input characters requiring special attention. Table 2-3 shows the special character detect RAM entries.

2.11.1 SPECIAL CHARACTER ARRAY DEFINITION

Source of a user initialization routine, RS.UDV, is supplied on USL. This routine is used to load the arrays used by the CP.

Figure 2-2 shows the default system array load program RS.UDV that is executed during user virtual mode initialization if a communication processor is present in the system environment. Upon examination of Figure 2-2, the system manager will notice that the special character array also contains information unrelated to asynchronous operations.

2.11.2 STANDARD ASCII READ DMI

Standard ASCII READ DMI requests use cell address 8 within array A and array B. The fields within these cells define the special characters:

NULL
CARRIAGE RETURN
RUBOUT/DELETE
BACKSPACE
System Default Break Character (CONTROL "A")

No special attention is required of the system manager in order for these characters to be properly handled.

ARRAY "A"									ARRAY "B"								
8 A1		4 A2		2 A3		1 A4		CELL	8 B1		4 B2		2 B3		1 B4		
DLE	*	STX	*	SOH	*	ENQ	*	0 -			EOT	*	ENQ	*	NAK	*	
#10	00	#02	01	#01	02	#2D	03		#03	40	#37	41	#2D	42	#3D	43	
DLE	*	SYN	*			ENQ	*	1 -	DLE	*	IUS	*	EOB	*	ETX	*	
#10	04	#32	05	#00	06	#2D	07		#10	44	#1F	45	#26	46	#03	47	
DLE		STX		SOH		ENQ		2 -			EOT		ENQ		NAK		
#10	08	#02	09	#01	0A	#05	0B		#03	48	#04	49	#05	4A	#15	4B	
DLE		SYN				ENQ		3 -	DLE		US		ETB		ETX		
#10	0C	#16	0D	#00	0E	#05	0F		#10	4C	#1F	4D	#17	4E	#03	4F	
#00	10	#00	11	#00	12	#00	13	4	#00	50	#00	51	#00	52	#00	53	
#00	14	#00	15	#00	16	#00	17	5	#00	54	#00	55	#00	56	#00	57	
#00	18	#00	19	#00	1A	#00	1B	6	#00	58	#00	59	#00	5A	#00	5B	
#00	1C	#00	1D	#00	1E	#00	1F	7	BKSPACE		X/ON		X/OFF				
									#08	5C	#11	5D	#13	5E	#00	5F	
NULL		CR		RUBOUT		CNTLR-A		8	BKSPACE		CNTLR-Q		CNTLR-S		ETX	&	
#00	20	#0D	21	#7F	22	#01	23		#08	60	#11	61	#13	62	#03	63	
#00	24	X/ON #11	25	X/OFF #13	26	CNTLR-A #01	27	9	#03	64	#37	65	#26	66	#3D	67	
ACK		CNTLR-Q		CNTLR-S		CNTLR-A		A	$		)		.		;		
#06	28	#11	29	#13	2A	#01	2B		#24	68	#29	69	#2E	6A	#3B	6B	
#10	2C	#37	2D	#2D	2E	#02	2F	B	#37	6C	#2D	6D	#03	6E	#26	6F	
#10	30	#70	31	#61	32	#7C	33	C	#10	70	#6B	71	#03	72	#26	73	
#10	34	#30	35	#31	36	#3B	37	D	#03	74	#04	75	#17	76	#15	77	
#10	38	#04	39	#05	3A	#02	3B	E	#04	78	#05	79	#03	7A	#17	7B	
#10	3C	#30	3D	#31	3E	#3C	3F	F	#10	7C	#3B	7D	#03	7E	#17	7F	

& STD BINARY
* EBCDIC CODES
- BISYNC CELLS
t TELETYPE

Table 2-3. Special Character Detect RAM Illustrations

```
TTL USER INITIALIZATION ROUTINE CP SPECIAL CHARACTER ARRAY

        PGM             RS.UDV
        INS             MC,IVSEQU
        INS             MC,IVUEQU
        INT             U$VINI
        EXT             ID$CCA
*
*       THIS ROUTINE IS SUPPLIED FOR CUSTOMERS UTILIZING THE OFFLINE
*       COMMUNICATIONS PROCESSOR FOR ASYNCHRONOUS AND BISYNCHRONOUS
*       DIRECT MEMORY TRANSFERS.  THE DIRECT MEMORY INTERFACE, THAT
*       THE CP USES, ALLOWS FOR UNINTERRUPTED TRANSFER REQUESTS.
*       THE CP HAS 2 ARRAYS, NAMED "A" AND "B" THAT HAVE A RANGE OF
*       32 WORDS EACH.  EACH ARRAY IS LOGICALLY BROKEN UP INTO
*       16 (ADDRESSED 0 TO 15) CELLS.  A CELL INCLUDES 2 WORDS OR
*       4 BYTES THAT ARE LABELED A,B,C, AND D FROM LEFT TO RIGHT.
*
*       THE PURPOSE OF THIS ROUTINE IS TO LOAD THE ARRAYS USED BY THE
*       CP.  THE ARRAYS DEFINE THE SPECIAL CHARACTERS OR CHARACTER
*       SEQUENCES TO BE DETECTED ON INPUT OPERATIONS.  THE LOADING OF
*       THE ARRAYS ONLY DEFINES THE CHARACTERS AND DOES NOT ENABLE THE
*       SPECIAL CHARACTER DETECT MECHANISM FOR CHANNEL INPUT.
*
U$VINI  EQU             $
        TBMM,PCP        LCBMST          TEST FOR CP SYSTEM PRESENCE
        BXCR,R8                         RETURN IF CP NOT PRESENT
        LDM,R4          ID$CCA          OBTAIN SYSTEM BREAK CHARACTER
        LDI,R6          SCATAB          ACCESS ADDRESS OF ARRAYS
        LDI,R7          35              STD ASC DMI BRK CHAR BYTE OFFSET
        SBX,R4,R6                       STORE SYSTEM BREAK CHARACTER
        LDI,R7          43              NONSTD ASC BRK CHAR BYTE OFFSET
        SBX,R4,R6                       STORE SYSTEM BREAK CHARACTER
        LDI,R7          #FFC0           ACCESS ARRAY SIZE IN BYTES
        DFC             #5360           LOAD SPECIAL CHARACTER ARRAYS
        BRX,R8                          RETURN TO CALLER
SCATAB  EQU             $
*       ARRAY A:
        DFC   #1002,#012D               ARRAY A - CELL 0 - BISYNC EBCDIC
        DFC   #1032,#002D               ARRAY A - CELL 1 - BISYNC EBCDIC
        DFC   #1002,#0105               ARRAY A - CELL 2 - BISYNC ASCII
        DFC   #1016,#0005               ARRAY A - CELL 3 - BISYNC ASCII
        DFC   #0000,#0000               ARRAY A - CELL 4 - UNUSED
        DFC   #0000,#0000               ARRAY A - CELL 5 - UNUSED
        DFC   #0000,#0000               ARRAY A - CELL 6 - UNUSED
        DFC   #0000,#0000               ARRAY A - CELL 7 - UNUSED
*       FIELD "D" IN THE NEXT CELL IS UPDATED WITH SYSTEM BRK CHAR
        DFC   #000D,#7F01               ARRAY A - CELL 8 - STD ASCII
        DFC   #0011,#1301               ARRAY A - CELL 9 - NSTDASC-BUFFDEV
*       FIELDS B, C, and D IN THE NEXT CELL IS UPDATED WITH SYSTEM
*       BRK CHAR
        DFC   #0611,#1301               ARRAY A - CELL A - NSTDASC-LISTCNT
        DFC   #1037,#2D02               ARRAY A - CELL B - 3271 EMULATOR
        DFC   #1070,#617C               ARRAY A - CELL C - 3271 EMULATOR
        DFC   #1030,#313B               ARRAY A - CELL D - 3271 EMULATOR
        DFC   #1004,#0502               ARRAY A - CELL E - 3271 EMULATOR
        DFC   #1030,#313C               ARRAY A - CELL F - 3271 EMULATOR
*       ARRAY B:
        DFC   #0337,#2D3D               ARRAY B - CELL 0 - BISYNC EBCDIC
        DFC   #101F,#2603               ARRAY B - CELL 1 - BISYNC EBCDIC
        DFC   #0304,#0515               ARRAY B - CELL 2 - BISYNC ASCII
        DFC   #101F,#1703               ARRAY B - CELL 3 - BISYNC ASCII
        DFC   #0000,#0000               ARRAY B - CELL 4 - ASYNC DMI USAGE
        DFC   #0000,#0000               ARRAY B - CELL 5 - ASYNC DMI USAGE
        DFC   #0000,#0000               ARRAY B - CELL 6 - ASYNC DMI USAGE
        DFC   #0811,#1300               ARRAY B - CELL 7 - STDASC-BUFFDEV
*       FIELDS B AND C IN THE NEXT CELL ARE UPDATED BY THIS ROUTINE
        DFC   #0811,#1303               ARRAY B - CELL 8 - STDASC-LISTCNT
        DFC   #0337,#263D               ARRAY B - CELL 9 - 3271 EMULATOR
        DFC   #2429,#2E3B               ARRAY B - CELL A - 3271 EMULATOR
        DFC   #372D,#0326               ARRAY B - CELL B - 3271 EMULATOR
        DFC   #106B,#0326               ARRAY B - CELL C - 3271 EMULATOR
        DFC   #0304,#1715               ARRAY B - CELL D - 3271 EMULATOR
        DFC   #0405,#0317               ARRAY B - CELL E - 3271 EMULATOR
        DFC   #103B,#0317               ARRAY B - CELL F - 3271 EMULATOR
        END
```

Figure 2-2. User Initialization Routine for CP Special Character Array

2.11.3 NON-STANDARD ASCII READ DMI

Non-Standard ASCII READ DMI requests require the system manager to define the input characters that will receive special attention and the user to properly address and enable these characters. Refer to the CLASSIC Communications Processor Model 3109, Computer Reference Manual for more information about the special character detect function of the CP. The description of the Load Special Character Algorithm (LSAL) instruction provides information useful to the system manager.

The system manager must define the character(s) and/or character sequences that require special attention within cells 4 through 6 only of array B. Figure 2-3 shows the field positions within a cell. Array A for Non-Standard ASCII READ requests is dedicated to the handler for Break character detect.

cell	field A	field B	field C	field D

Figure 2-3. Array B - Special Character Detection, Cells 4, 5 and 6

Specifications of Non-Standard ASCII READ special detection character(s) and character sequences can be accomplished as follows:

- Single Character Termination

  Place character(s) to be detected in any field(s) within cells 4 through 6 of Array B.

- Termination on detection of a unique character followed by up to 4 consecutive additional characters.

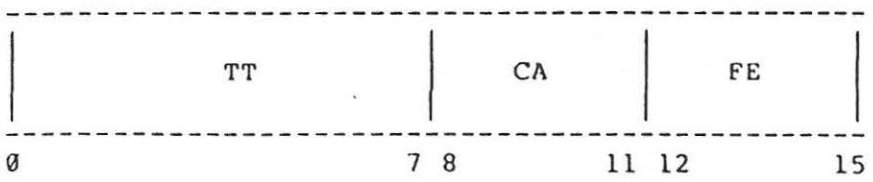
  Place the unique character in field A within a cell (4 through 6) of Array B.

- Termination on detection of two consective unique characters followed by up to 3 consecutive additional characters.

  Place the first unique character in field A of any cell (4 through 6) of Array B along with the second unique character in any other field of the same cell.

Request addressing and enabling of the special termination character(s) or character sequences is accomplished as follows:

Step 1 - Construction of detection algorithm word:



where TT (Termination Type) is the most significant byte of the word and defines the detection algorithm to be used as follows:

#E0 means single character termination

#Fn means one or two unique consecutive characters followed by up to three or four additional consecutive characters will terminate the input stream. The first or only unique character must be in field A.

- n=0 means two unique characters and zero additional characters
- n=1 means two unique characters and one additional character
- n=2 means two unique characters and two additional characters
- n=3 means two unique characters and three additional characters
- n=4 means one unique character in field A and one additional character
- n=5 means one unique character in field A and two additional characters
- n=6 means one unique character in field A and three additional characters
- n=7 means one unique character in field A and four additional characters

where CA is the cell address in array B. The range of this address is 4 through 6 only.

where FE is the field(s) enabled within the cell addressed.

Bits 12 - 15 identify enabled fields.

Bit 12 = 1 to enable field A
13 = 1 to enable field B
14 = 1 to enable field C
15 = 1 to enable field D

NOTES:

1. If single character termination is desired, (TT=#E0), usage of more than one character for termination is not precluded and can be defined by enabling more than one field within a cell.

2. When the termination sequence starts on a "unique" character, (TT=#Fn) the first or only unique character must be in field A of the cell addressed. If there are two unique consecutive characters that start the termination sequence, then the second unique character must be placed in the same cell as the first unique character and its associated field must be enabled. It is feasible to have both unique consecutive characters be the same character in which case field A

Step 2 - The detection algorithm word is stored in the Non-Standard ASCII Terminator Table, CM.TRT. Refer to Figure 2-4.

Step 3 - To make the connection between a users Non-Standard ASCII READ REX Service and a detection algorithm word use the least significant 7 bits of the UFTOPT word to index into the appropriate detection algorithm word within CM.TRT (Figure 2-4).

```
                    TTL  NON-STANDARD ASCII TERMINATOR TABLE

        PGM             CM.TRT
        INT             CM$TRT
*       THIS TABLE IS USED BY THE HANDLER FOR NON-STANDARD
*       ASCII INPUT OPERATIONS.  IF THE USER HAS SPECIFIED
*       A TERMINATOR, THEN THE LEAST SIGNIFICANT BYTE OF
*       UFT WORD UFTOPT IS USED AS AN INDEX INTO THIS
*       TABLE IN ORDER TO RETRIEVE THE DETECTION ALGORITHM
*       WORD (DESCRIBED EARLIER UNDER COMMUNICATIONS
*       PROCESSOR USAGE).  TO AVOID CONFLICT WITH EMULATOR
*       PACKAGES, THE USER SHOULD USE TABLE WORDS THAT
*       EQUAL #FFFF.

CM$TRT  EQU             $
        LST  1
*                0 1   2 3   4 5   6 7   8 9   A B   C D   E F
        DFC   #200A,#094F,#490B,#28FF,#60FF,#29FF,#2A21,#FFFF   0
        DFC   #08FF,#FFFF,#FF4B,#0D4E,#FFFF,#FFFF,#FFFF,#FFFF   1
        DFC   #FFFF,#FFFF,#68FF,#FFFF,#FF69,#FFFF,#FFFF,#6AFF   2
        DFC   #FFFF,#05FF,#FFFF,#FFFF,#FFFF,#FF6B,#FFFF,#FFFF   3
        DFC   #FFFF,#FFFF,#FFFF,#FFFF,#FFFF,#FFFF,#FFFF,#FFFF   4
        DFC   #FFFF,#FFFF,#FFFF,#FFFF,#FFFF,#FFFF,#FFFF,#FFFF   5
        DFC   #FFFF,#FFFF,#FFFF,#FFFF,#FFFF,#FFFF,#FFFF,#FFFF   6
        DFC   #FFFF,#FFFF,#FFFF,#FFFF,#FFFF,#FFFF,#FFFF,#FFFF   7
        LST
        END
```

Figure 2-4. Non-Standard ASCII DMI Mode Terminator Table

2.11.4 CP INPUT SPECIAL CHARACTER DETECTION EXAMPLES

Assuming that cells 4 through 6 of Array B, have the following values:

```
Cell 4: #4142, #4344
Cell 5: #4546, #4748
Cell 6: #494A, #4B4C
```

Using the following detection algorithm words will produce the indicated results:

#E041 - Single character termination, cell 4, field D enabled. Terminate input on detection of the character "D".

#E049 - Single character termination, cell 4, fields A and D enabled. Terminate input on detection of the character "A" or "D".

#F450 - Unique character termination, cell 5, (field A used). Terminate input on detection of the character "E" followed by one additional character.

#F760 - Unique character termination, cell 6, (field A used). Terminate input on detection of the character "I" followed by four additional characters.

#F068 - Unique character termination, cell 6, (field A used) field A enabled. Terminate input on detection of the character sequence "II".

#F069 - Unique character termination, cell 6, (field A used) fields A and D enabled. Terminate input on detection of the character sequence "II" or "IL".

2.12 SYSGEN STATEMENTS FOR COMMUNICATIONS CHANNELS

The addition of communications software to the MAX IV Basic Input/Output System has necessitated a unique approach due to the nature of the communications hardware. The asynchronous channel half-plane controller and multiplexors require what amounts to a party-line within a party-line. This leads to the requirement of the COMCONTROLLER macro. Furthermore, each communications controller requires the definition of channels that are considered as simplex channels for the sake of SYSGEN. Each full-duplex channel is considered to be made up of a pair (1 input, 1 output) of simplex channels.

The physical channels are numbered continuously starting with zero. All even-numbered channels are the output channels of the pair; the odd-numbered channels are the input channels. Each COMCONTROLLER macro call references those physical channels that it is defined to service. For half-duplex channels only the even numbered (output) channel of the pair is specified but both channels will actually be used. A COMDEVICE macro call is required for each logical device attached to those channels. Several logical devices may be defined for a physical channel; however, those channel characteristics that are defined by the COMCONTROLLER statement are only defined once. Therefore, a physical duplex channel may be configured as one or two simplex channels, a half-duplex channel or a full-duplex channel.

2.12.1 COMCONTROLLER

DEFINE EACH COMMUNICATIONS CONTROLLER CHANNEL

The COMCONTROLLER statement must be specified for each communications line to be used in your MAX IV system. One PDT (Physical Device Table) is generated for each statement specified and for each group of statements specifying the same group and unit, a multiplexor table and appropriate driver code are generated. Additionally, this statement causes the appropriate device handler to be included in your system during the link-edit phase of system generation. COMCONTROLLER statements of one group-unit number, "gu", must not be intermixed with COMCONTROLLER statements of another group-unit number, "gu".

SYNTAX

```
                          1   2   3       4          5     6     7
COMCON[TROLLER]  hxx,#gu,chnl[,UNTIMED][,fdc][,fdn],cls
                                [,TIMED  ]
                                [,VACANT ]

                           8     9
                        [,NET][,CL]
```

hxx - Parameter 1 is the communications controller channel name and must be unique to all controller names specified, where:

h = A for an Asynchronous channel
xx = Any unique CAN-code character pair

#gu - Parameter 2 is the even group and unit number concatenated into one hexadecimal quantity for this controller.

chnl - Parameter 3 is the 3-character controller channel number. For half-duplex, a COMCONTROLLER statement is required for each even numbered channel; for full-duplex, separate COMCONTROLLER statements are required for each output (even) and input (odd) channel.

[UNTIMED]
[TIMED]
[VACANT] - Parameter 4 is an optional keyword that determines whether this controller is timed. The default value for this parameter is UNTIMED. VACANT specifies that this channel is to be skipped. This parameter leaves a hole in the multiplexor table. If VACANT is specified, Parameters 1, 2, 3, 4, and 7 are the only parameters evaluated.

[fdc] - Parameter 5 is used only for full-duplex channels. It specifies the other channel number of the half-duplex channel to be used in conjunction with this one to configure a full-duplex pair: the mate.

[fdn] - Parameter 6 is used only for full-duplex channels. It specifies the other controller name, as specified in Parameter 1, of the "mate" (see description of Parameter 5).

cls - Parameter 7 specifies the controller class. Enter one of the following Keywords to define the class of the controller:

A = 4810,4811,4812,4813,1905
C = 1906
D = 4804,4808,4809,4858,1907,1907A,1907B,1908(DI)
F = 1907,1907A,1907B,1908(DMI)
I = 4806,4807

[NET] - Parameter 8 is a keyword used to specify to the system that this channel will be used as a CPU link by the MAXNET symbiont.

[CL] - Parameter 9 is an optional keyword used to specify that an asynchronous device has a current loop interface and is required for 1907/1907A type async channels where applicable. The default is not current loop.

2.12.2 COMDEVICES

DEFINE EACH COMMUNICATIONS "DEVICE" IN SYSTEM'S LOGICAL DEVICE LIST

One COMDEVICE statement is required for each COMCONTROLLER statement specified in your MAX IV system. The expansion of this macro creates a logical device table entry (LDT) and establishes a fixed assignment of that logical device to a physical device (PDT).

The asynchronous communications handlers are designed to function with several different types of devices. However, some of these devices have peculiar characteristics that must be distinguished by the handlers. Bits are set in the LDT option word (LDTTYP) at SYSGEN time to indicate to the handler the device peculiarities. Refer to the "options" Parameter 4 and Figure 2-4 below.

SYNTAX

```
                    1   2    3        4           5              6
COMDEV[ICE]    dxx,hxx[,bpr][,options][,exclutask ][,watchdog]
                                                [,-influence]

                      7        8         9          10       11
                  [,chrsiz][,parity][,stopbits][,echo][,nullcnt]

                    12       14    15
                  [,baud][,,bof][,plc]
```

dxx - Parameter 1 is the logical device name and must be unique to all device names specified (communications channels), where it is recommended:

d = A for Asynchronous devices.
xx = Any unique CAN-code character pair.

hxx - Parameter 2 is the name of the communications controller to which this logical device is connected (see COMCONTROLLER statement).

[bpr] - Parameter 3 is the maximum bytes per record that this device accepts (0-256). If zero is specified, the record size is considered "unlimited".

[options] - Parameter 4 permits modification of the contents of the logical device characteristics word in the data structure (LDT) for this device. It specifies certain options that may be examined by the specific handler when a handler supports many similar but not identical types of devices. This LDT Option Word is shown in Figure 2-4. The meaning of the bits are explained below. (For MAXNET options see the MAXNET Reference Manual).

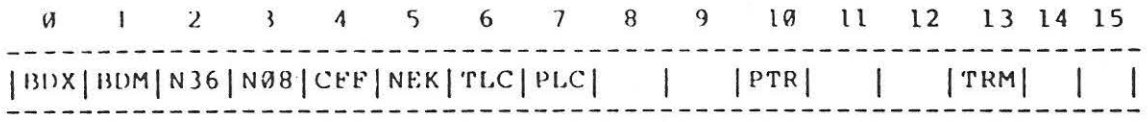


Figure 2-4. Asynchronous Device LDT Option Word

BIT	NAME	MEANING IF SET
0	BDX	Enable Buffered Device X/ON-X/OFF Support.
1	BDM	Enable Buffered Device Modem Signal Support.
2	N36	Output 36 Null characters after LF's. Output 209 Null characters after FF's.
3	N08	Output 8 Null characters after LF's. Output 53 Null characters after FF's.
4	CFF	Device has hardware form-feed capability.
5	NEK	Perform software (handler) echo of input.
6	TLC	Enable Terminal Listing Control.
7	PLC	Device used for Programmable Logic Controller (PLC) Interface
10	PTR	Device capable of printing.
13	TRM	Device has keyboard.

[exclutask]
[-influence] - Parameter 5 is optional. It specifies either a task name or a negative influence limit. If a task name is given, the designated task is given permanent exclusive use of the device to the complete exclusion of all other tasks.

If a negative influence limit number in the range of -000 or -255 is given, then only tasks that have an influence limit number with absolute value less than or equal to the absolute value of this parameter are permitted to use this logical device. The default is a negative influence limit number of -255.

[watchdog] - Parameter 6 is the maximum time in basic clock interrupt periods that an operation to this device will be allowed to stay at the head of the queue of its controller. This word has no meaning if Parameter 4 of the COMCONTROLLER statement specifies UNTIMED.

[chrsiz] - Parameter 7 specifies the data character (frame) size in bits and may be specified as: 5, 6, 7 or 8. This value is the actual number of bits transferred from/to memory; the default is 8.

[parity] - Parameter 8 is a keyword specifying the parity and may take on the following values:

EVEN for even parity,
ODD for odd parity or,
NONE for no parity (default).

Character parity, when specified, is generated and checked by the channel hardware. ASCII terminals that have the parity bit as always a space (Ø) should normally specify the character size as 8 and the parity as NONE. ASCII terminals that have the parity bit as always a mark (1) should change the parity option in the terminal to a space, odd or even parity.

[stopbits] - Parameter 9 specifies the number of stop bits and may be specified as the value 1 or 2 (default). This parameter has meaning for asynchronous devices only.

[echo] - Parameter 1Ø is a keyword used to specify the presence and type of echo, and may be specified as follows:

HARD for hardware echo,
SOFT for software echo (sets Bit 5 of LDT Option Word) or,
NOECHO for no echo (default).

This parameter has meaning for the input side of full-duplex asynchronous devices only.

Full-duplex and echo I/O will cause abort of output due to inability of hardware to simultaneously echo and output data.

[nullcnt] - Parameter 11 specifies the number of null characters to be transmitted following a line feed. The default is Ø if neither bits (NØ8 or N36) are set in the LDT option word.

[baud] - Parameter 12 specifies the line speed for the 4804, 4806, 4807, 4808, 4858, 1907, 1907A, 1907B, and 1908 controllers. The following baud rates can be specified: 75, 11Ø, 134 (for 134.5), 15Ø, 3ØØ, 6ØØ, 12ØØ, 18ØØ, 2ØØØ, 24ØØ, 36ØØ, 48ØØ, 72ØØ, 96ØØ, 19.2 (indicating 19.2K baud), or the keyword EXTD for Extended/External (where the timing is supplied externally). When using a 4858 controller, the highest selectable baud rate is 96ØØ. If this parameter is omitted, 12ØØ baud will be assumed by default.

- Parameter 13 should be defaulted.

[bof] - Parameter 14 is optional. It identifies the bottom-of-form simulation support count. This is the number-of-lines per page. Default is to use hardware bottom-of-form signal. This function is designed for use on output (printer) devices or on output channels only.

[plc] - Parameter 15 is used only when the PLC option is selected (Bit 7 set in parameter 4 above). When the PLC bit is set, parameter 15 identifies the Programmable Logic Controller type that is interfaced to this COMDEVICE.

For PLC type:	Set Bit:
Square D	11
Texas Instrument PM 550	12
General Electric Series 6	13
Gould, Modicon	14
Allen-Bradley	15

2.12.3 BRKCHARACTER

DEFINE SYSTEM BREAK CHARACTER

The BRKCHARACTER statement is optional. It specifies the system break character used on the main console and remote terminals.

Break Character processing is described within the BREAK-DETECT FUNCTION section of this chapter. The system break character defaults to CONTROL "A" if this statement is not included in the SYSGEN source file.

SYNTAX

```
                          1
BRKCHA[RACTER]    [character]
```

character - Parameter 1 is optional. It specifies the system break character, usually expressed as a hex value. It defaults to CONTROL "A". The system break character should not conflict with listing control characters or buffered device X/ON-X/OFF characters.

2.12.4 LISTCONTROL

DEFINE TERMINAL LISTING CONTROL INFORMATION

The LISTCONTROL statement is optional. It defines the system listing control characters and automatic listing resume time interval. Terminal Listing Control processing is described in this chapter. The system listing stop character defaults to CONTROL "S" and the system listing resume character defaults to CONTROL "Q" if this statement is not included in the SYSGEN source file.

SYNTAX

```
                          1     2     3
LISTCO[NTROL]    [lsc][,lrc][,lri]
```

lsc - Parameter 1 is optional. It specifies the Listing Stop Character. This parameter is usually expressed as a hex value. The default for this parameter is #13 or CONTROL "S".

lrc - Parameter 2 is optional. It specifies the Listing Resume Character. This parameter is usually expressed as a hex value. The default for this parameter is #11 or CONTROL "Q".

lri - Parameter 3 is optional. It specifies the Automatic Listing Resume Time Interval. This parameter specifies the number of ticks in the interval to be used by the handler in automatically resuming a held output listing. The timer operates at the low clock level and begins whenever a stop listing condition is detected upon starting up an output operation. The default for this parameter is Ø which indicates that listings are not to be automatically resumed.

The following characters are RESERVED and may not be used as Listing Stop/Resume Characters:

System Break Character (the default is CONTROL "A" (#Ø1))
DELETE/RUBOUT (#7F)
Carriage Return (#ØD)
Backspace (#Ø8)
NUL (#ØØ)

2.12.5 LINEMONITOR

DEFINE COMMUNICATION LINE MONITORING CHARACTERISTICS

The LINEMONITOR statement is optional and is used only if a Break/Ring processing task is to be included in the system. This statement is not required for the Operator Communications Task and its terminal to detect Break. This statement is required for each communications line for which Break/Ring will be queued to some line monitoring support task. One such task is supplied by MODCOMP to provide for Remote Operator Communications and Auto Answer support (this task is called the Terminal Monitor Program - TMP); however, any number of user tasks may also exist in the system.

SYNTAX

```
                  1       2          3         4         5         6
    LINEMON    output[,input][,options][,task][,prefix][,delay]
```

output - Parameter 1 is the logical device name on which BREAK, CONTROL "A", RING, and LINE DISCONNECT are to be detected. If the device is a full-duplex device, "output" is the name of the device on the output channel.

[input] - Parameter 2 is only required if the device is a full-duplex device. If the device is half-duplex, either this parameter must not be entered or must be entered the same as parameter 1. If the device on which BREAK, CONTROL "A", RING, and LINE DISCONNECT is to be detected is a full-duplex device, "input" is the logical device name of the device connected to the input channel.

[options] - Parameter 3 is optional. It specifies line monitoring characteristics as follows:

Break Support	BREAK	(#2000)
Ring Support	RING	(#1000)
Auto Task Line Connect Support	CONN	(#0800)
Auto Task Line Disconnect Support	DISC	(#0400)
Line Disconnect Delay Support	DELAY	(#0200)

Auto Task Line Connect Support, Auto Task Line Disconnect Support, and Line Disconnect Delay Support require that Ring Support be optioned. The default option is BREAK support.

[task] - Parameter 4 is optional. It specifies the task name that is to be notified (by a packet queued to it) when a BREAK, RING, or LINE DISCONNECT is detected from the supported device. All these task names must be only 3 characters long. The default task name is TMP (Terminal Monitor Program).

[prefix] - Parameter 5 is optional. It specifies a 3 character CAN-codable task name prefix to be used as the prefix to the initial attentive task name. The 3-character suffix to the task name will be the line number in decimal ASCII. A line number is based on the LINEMONITOR statement ordering. The line number of the first LINEMONITOR statement is "001". The line number of each additional statement is "002", "003", et cetera. If this parameter is not supplied then there will be no initial attentive task name.

[delay] - Parameter 6 is optional. It specifies the number of ticks to delay after detecting a line disconnection. The time delay operates at low clock level. This parameter is used in conjunction with Line Disconnect Delay Support (DELAY) only and the default delay is 3 seconds or 600 ticks.

2.12.6 SYSGEN STATEMENT EXAMPLES

```
COMCONTROLLER    A00,#18,000,,001,A01,A
COMCONTROLLER    A01,#18,001,,000,A00,A
```

Define a full-duplex asynchronous channel (PDT) for controller addresses #18 and #19.

```
COMCON    AT1,#1A,000,TIMED,,,A
COMCON    AT2,#1A,002,TIMED,,,A
COMCON    AT3,#1A,004,TIMED,,,A
```

Define three timed half-duplex asynchronous channels for controller addresses #1A and #1B.

```
COMDEVICE    A00,A00,80,,,,8,NONE,1
COMDEVICE    A01,A01,80,,,,8,NONE,1
```

Define a full-duplex asynchronous channel (LDT) for device addresses #18 and #19 using subchannels 00 and 01 as defined on the COMCONTROLLER statement.

```
COMDEV      AT1,AT1,74,,,,8,NONE,2
COMDEV      AT2,AT2,74,,,,7,EVEN,2
COMDEV      AT3,AT3,74,,,,7,ODD,1
```

Define three half-duplex channels with unit record sizes specified for a teletype.

```
BRKCHARACTER      #07
```

Specifies CONTROL "G" as the system break character.

```
LISTCONTROL       #06,#07
```

Specifies CONTROL "F" as listing stop character and CONTROL "G" as listing resume character.

NOTE: These BRKCHA and LISTCO examples cannot appear in the same system. CONTROL "G" (#07) cannot be defined as both a break character and a listing control character.

```
LISTCO      ,,500
```

Another example of LISTCO. Only one LISTCO statement should be used in the SYSGEN source file. This example specifies an automatic listing resume interval as 500 ticks using the default listing control characters.

```
LINEMONITOR       A00,A01,BREAK,TMP
```

Specifies full-duplex device with break support.

```
LINEMO      A02,,BREAK,TMP
```

Specifies half-duplex device.

```
LINEMO      A04,A05,RING,TMP,BAT
```

Specifies full-duplex device with ring support. The attentive task name is BAT001.

```
LINEMO      A06,,BREAK+RING+CONN+DISC+DELAY,TMP,BAT,600
```

Specifies all supported options and a disconnect delay of 600 ticks.

	ASCII MODES		BINARY MODES	
	STANDARD	NON-STANDARD	STANDARD	NON-STANDARD
0 READ	INPUT ONE RECORD LINE FROM KEYBOARD. OUTPUT CR OR NUL-OUTPUT PREFIX (CR,LF) BEFORE INPUT.	INPUT ONE RECORD FROM KEYBOARD (USER-SPECIFIED TERMINATOR)- NO PREFIX-TO PRINTER.	INPUT ONE RECORD WHOSE LENGTH IS BASED ON THE USER-DEFINED BYTE COUNT CONTAINED IN THE RECORD.	INPUT ONE RECORD WHOSE LENGTH IS BASED ON THE USER-DEFINED BYTE COUNT CONTAINED IN THE REX CALL
1 WRITE	OUTPUT ONE LINE TO PRINTER OUTPUT. PREFIX AS PER CARRIAGE CONTROL BYTE INTERPRETATION.	OUTPUT ONE LINE TO PRINTER -NO PREFIX- TO PRINTER.	OUTPUT ONE RECORD WHOSE LENGTH IS BASED ON THE USER-DEFINED BYTE COUNT CONTAINED IN THE REX CALL	<-----SAME
2 REWIND	OUTPUT SIMULATED (CR,4LF) OR TRUE FORM-FEED (FF) TO PRINTER. SETS EOF AND BOM IN UFT STATUS WORD.	<-----SAME	<-----SAME	<-----SAME
3 BKFILE	NULL FUNCTION SETS EOF AND BOM EVENTS IN UFT STATUS WORD.	<-----SAME	<-----SAME	<-----SAME
4 BKRECORD	NULL FUNCTION SETS EOF AND BOM EVENTS IN UFT STATUS WORD.	<-----SAME	<-----SAME	<-----SAME
5 AVRECORD	ADVANCE CARRIAGE OF PRINTER ONE LINE (CR,LF).	<-----SAME	<-----SAME	<-----SAME
6 AVFILE	ADVANCE CARRIAGE OF PRINTER FOUR LINES (CR,4LF).	<-----SAME	<-----SAME	<-----SAME
7 WEOF	OUTPUT FILE-MARK ($$) RECORD TO PRINTER WITH (CR,2LF) LEADER PREFIXED. SETS EOF IN UFT STATUS WORD.	<-----SAME	<-----SAME	<-----SAME
8 HOME	ENABLING AND DISABLING OF INTERNAL CHANNEL WRAPAROUND MODE AND/OR LINE DISCONNECTION REQUESTS.	<-----SAME	<-----SAME	<-----SAME

Table 2-4. Asynchronous Communications Operations and Modes

PROGRAMMER'S ERROR/EVENT BIT IN DFTSTA	OPERATOR'S REASON CODE	REASON FOR ERROR/EVENT IF SET
1	OVF	INPUT CHANNEL OVERRUN
2	PAR	INPUT CHANNEL PARITY
3	INO	-DEVICE DOES NOT EXIST OR DOES NOT RESPOND -DEVICE INOPERABLE -WATCHDOG TIMER HAS EXPIRED -DMI NOT PRESENT
4	MPE	MEMORY PARITY (DMI ONLY)
5	LOK	MODEM MALFUNCTION (DSR, CARRIER DETECT, OR CLEAR-TO-SEND DROPPED)
6	CIG	-OUTPUT CHANNEL RING DETECT -INPUT CHANNEL FRAME ERROR
7	OTH	
8	SBV	
9	EOM END-OF-MEDIUM	-NONE-
10	EOF END-OF-FILE	-$$CR (FOR TERMINAL DEVICE). -ALSO SET AFTER WEOF, REWIND, OR NULL.
11	BOM BEGINNING-OF-MEDIUM	SET AFTER REWIND OR NULL OPERATION.

DISCLAIMERS

1. Leading carriage return/line feed characters are not suppressed in DMI mode.

2. Trailing blank (ASCII space) suppression is ignored in DMI modes.

Table 2-5. Asynchronous Communications Errors and Events

CHAPTER 3
MAX IV BISYNCHRONOUS COMMUNICATIONS HANDLERS

The user should have a thorough understanding of the Binary SYNCHRONOUS (BISYNC) transmission methods before attempting to utilize this handler. For a complete description of BISYNC procedures, and therefore much of the terminology in this chapter refer to the manuals for the MAX IV 2780/3780 Emulator listed in the Related Publications section of the PREFACE.

The Binary SYNCHRONOUS (BISYNC) device handler is a resident MAX IV element consisting of a TASK level preparation routine and directly connected SERVICE and DATA interrupt routines utilizing unique hardware party-line interrupt vectors. These are permanent resident elements capable of controlling the transfer of data, status and commands over MODCOMP synchronous channels to and from the class of devices that utilizes the BISYNC transmission methods. Synchronous transmission, independent of Bisync, is also supported.

3.1 STANDARD CONTROLLERS AND DEVICES

There are three handlers that support synchronous communications. The handler BI.HAN supports Synchronous, Binary Synchronous (Bisync) and 200 User Terminal protocol in a DI mode only on the following models of controllers: 4804, 4815, 4817, 1906, 1907, 1907A, 1907B, and 1908. The second handler is SY7.HA and it supports Synchronous communication on the 1907, 1907A, 1907B, and 1908 in DMI mode only. The third is BI7.HA and it supports Binary Synchronous Communications on a the 1907, 1907A, 1907B, and 1908 in DMI mode only.

3.2 MODES SUPPORTED

The BISYNC handler supports eight input/output modes. These include four special BISYNC modes, in addition to the four MODCOMP standard I/O modes. The four special BISYNC modes include BISYNC formatted records with USASCII control character set, BISYNC formatted with an EBCDIC control character set, and unformatted (fixed length) records with either character set specified. Control characters supply the handler with information concerning the records structure. The two control character sets differ only in binary configuration; the character mnemonics are the same.

3.3 TIMER OPTION

As a result of the BISYNC protocol, the user may choose to time READ and/or WRITE operations, so that he/she may receive control again if no data is received within the specified time period. If the timer is a user dependent value, the user should supply the timer value in register 3 when the REX call is made. The timer value represents system ticks where one system tick = 5 ms. If the timer value is such that it is not user dependent, it may be supplied in the Logical Device Table at System Generation time.

Optionally, the user may choose no timing at all. Timer specification is supplied by the user in the device dependent portion of the Extended Option Word in the (XUFOPT).

When supplying a user specified timer, the operations will be timed only if the COMCONTROLLER is defined as a TIMED controller at SYSGEN.

The 2780/3780 Emulator will queue up a read for the response before issuing the data write. Both the READ and the WRITE operations are timed to support this, if Bit 10 of the Extended UFT Option Word is set, the read timer will be stopped when the WRITE operation starts up. When the WRITE completes, the read timer is started up again.

3.4 USER FILE TABLE (UFT)

A User File Table must be assembled within the user's program and contain entry and return arguments associated with the REX Service for a standard device I/O operation. Requests for READ or WRITE I/O operations utilizing BISYNC formats must include device dependent data in the UFT. These option words are displayed in Figures 3-1 and 3-2.

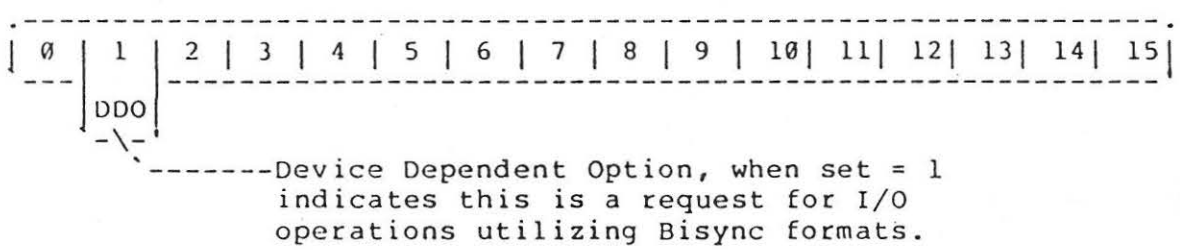

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
DDO
Device Dependent Option, when set = 1
indicates this is a request for I/O
operations utilizing Bisync formats.

Figure 3-1. UFT Option Word UFTOPT

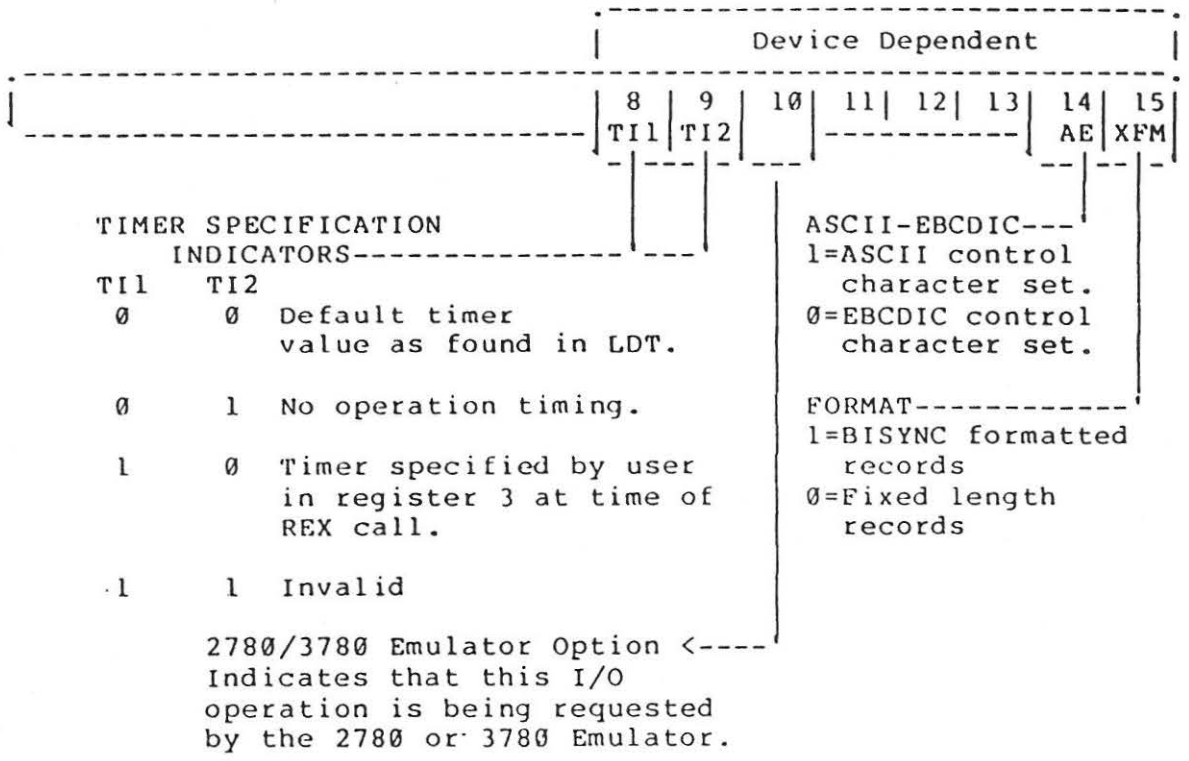

Device Dependent
8 TI1
9 TI2
10
11 12 13
14 AE
15 XFM
TIMER SPECIFICATION INDICATORS
TI1 TI2
0 0 Default timer value as found in LDT.
0 1 No operation timing.
1 0 Timer specified by user in register 3 at time of REX call.
1 1 Invalid
2780/3780 Emulator Option
Indicates that this I/O operation is being requested by the 2780 or 3780 Emulator.
ASCII-EBCDIC
1=ASCII control character set.
0=EBCDIC control character set.
FORMAT
1=BISYNC formatted records
0=Fixed length records

Figure 3-2. Extended UFT Option Word XUFOPT for READ or WRITE

The BISYNC handlers will return unique status information in the UFT STATUS word with certain BISYNC protocol information on return from REX calls requesting BISYNC I/O operations. These interpretations are indicated in Figure 3-3.

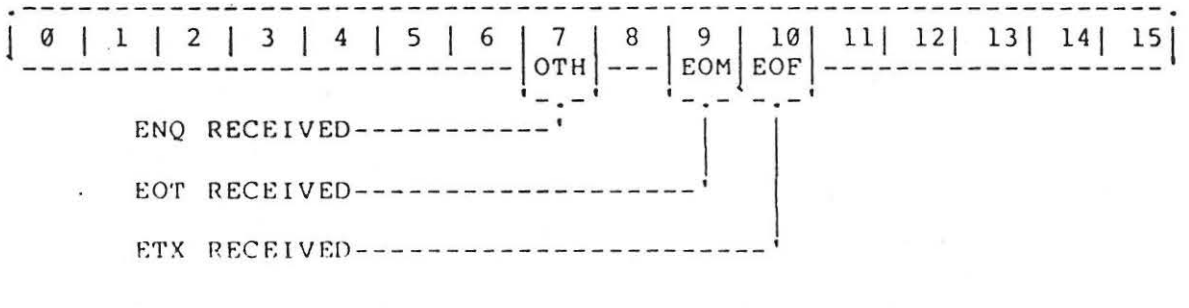


Figure 3-3. Status Word (#0) of UFT (UFTSTA) Returned by BIOS

3.5 SYSTEM INTERFACE

In order to use BI7.HA the user is required to provide a program module that will load the special character RAM in the communications processor (CP). Figure 2-2 in the Asynchronous Handlers chapter contains an example of such a module. BI7.HA requires the first four cells in both A and B arrays to be loaded as shown. The first four cells in Array A are bytes #00-#0F. The first four cells in Array B are bytes #40-#4F.

3.6 RESPONSES TO OPERATIONS AND MODES

3.6.1 STANDARD MODES

3.6.1.1 Standard ASCII READ From Synchronous Device

One record is read into the user's buffer from the synchronous device. Leading Carriage Returns and Line Feed characters are deleted from the text, as are trailing Line Feed, Backspace and Rubout characters. Trailing Carriage Return and Null characters are recognized as terminator characters.

3.6.1.2 Non-Standard ASCII READ From Synchronous Device

One record is read into the user's buffer from the synchronous device. The terminator character is a Null character, or selected by the user, when it is supplied in the option word of the UFT when the operation is queued.

3.6.1.3 Standard Binary READ From Synchronous Device

One record is read into the user's buffer from the synchronous device. The read operation terminates after the byte count specified within the binary record has been read. However, the number of bytes stored in the user's buffer may be either the user specified byte count, or the record byte count, whichever is less.

3.6.1.4 Non-Standard Binary READ From Synchronous Device

One record is read into the user's buffer from the synchronous device. The READ operation terminates after the user specified byte count has been read.

3.6.1.5 ASCII WRITE To Synchronous Device

One record is written from the user's buffer to the synchronous device. The Standard ASCII WRITE operation terminates on expiration of user specified byte count or upon detection of a NUL character. The Non-Standard WRITE operation terminates on a NUL character, expiration of byte count, or upon detection of a user specified terminator.

3.6.1.6 Binary WRITE To Synchronous Device

One record is written from the user's buffer to the synchronous device. The Standard Binary WRITE operation terminates upon expiration of the user specified byte count or the binary record specified byte count, whichever is smaller. The Non-Standard Binary WRITE operation terminates upon expiration of the user specified byte count.

3.6.2 BISYNC MODES

3.6.2.1 BISYNC FORMATTED READ From Synchronous Device

One block, formatted according to the BISYNC transmission methods, is read into the user's buffer. The READ operation will terminate when the specified number of bytes has been read or when a terminate condition is recognized. A terminate condition is specified by the control characters that indicate the record's structure.

The control characters that indicate terminate conditions are:

- ITB, ETB, ETX
- DLE
- ENQ, NAK, EOT
- SYN Synchronization
- STX Start-of-Text

Terminator Characters (ITB, ETB, ETX) indicate to the handler that two Block Check Characters (one character if ASCII) are to follow. If the terminator is an ETB or an ETX, the READ operation will be terminated after the last Block Check Character is stored in the user's buffer. Otherwise, the READ operation will continue.

Data Link Escape (DLE) character indicates to the handler that it should transfer one more character, and then terminate if this is a non-transparent block. If this is a transparent block, the handler will treat the next character as a control character, unless the next character is a DLE. The handler will treat the DLE-DLE as text (in a transparent block).

The transparency mode utilizes a series of dual character sequences. The DLE character always leads, and the two characters together comprise a control character. The transparent mode concept allows the program to use more data character representations.

Enquiry (ENQ) character, Negative Acknowledgement (NAK), and End of Transmisson (EOT) indicate that the handler stores the character and terminates the READ operation.

Synchronization (SYN) character is ignored by the handler and is not stored in the user's buffer. In transparent text, the dual-character sequence DLE-SYN is left out of the user's buffer.

Start-of-Text (STX) character is treated as a data character, and the proper text mode is recognized (Transparent text mode for DLE-STX, Non-transparent text mode for STX).

3.6.2.2 FIXED LENGTH READ From Synchronous Device

The user specified number of bytes will be read from the synchronous device into the user's buffer.

3.6.2.3 BISYNC WRITE To Synchronous Device

The user specified number of bytes will be written from the user's buffer to the Binary Synchronous Device. The last data character will be followed by a "PAD" character that consists of all "1" bits. The "PAD" character is required to ensure that the preceeding character is received before the transmitter shuts down.

3.6.2.4 HOME To Synchronous Device

The HOME REX service is processed by the Bisynchronous Communications handlers to issue Internal Wraparound (IW), reset Data-Terminal-Ready or Disconnect-Line requests. Tasks requesting Internal Wraparound must be privileged and should understand the ramifications of exercising Internal Wraparound on a duplex channel. The privileged state is required whether enabling or disabling Internal Wraparound.

Only REX HOME Services issued to the output channel (even numbered channel) affect IW states. The options are specified by the Device Dependent bits (8 through 15) of the Extended UFT Option Word (XUFOPT). Figure 3-4 shows the options available with a REX HOME request.

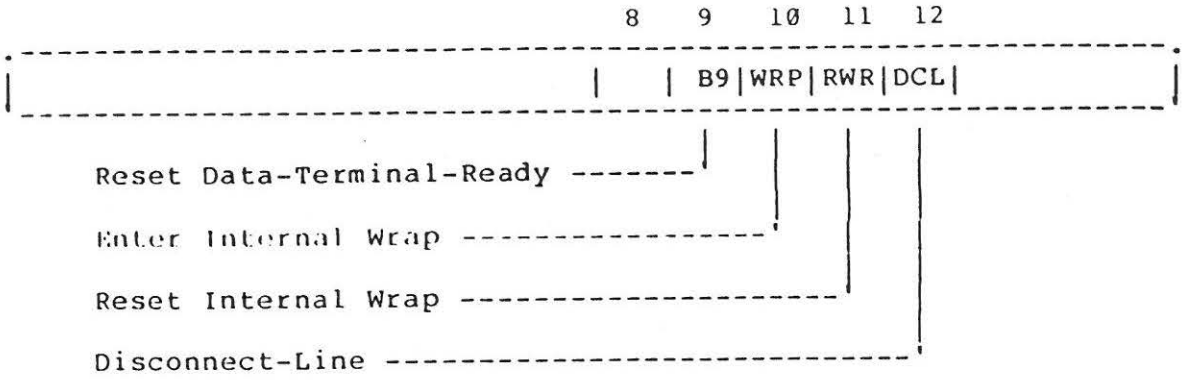


Figure 3-4. Extended UFT Option Word XUFOPT for HOME

Internal Wraparound (IW) support allows the output subchannel of a duplex channel to transmit to the input subchannel of the same duplex channel. While a duplex channel is in Internal Wraparound mode. The following functions are disabled:

- o Break key support (not available on the 481X controllers)
- o Break character support
- o Echoplex handling
- o External transmitting of data

IW loops transmit data back to receive data and forces a mark condition to the modem/line interface.

The user is responsible for output subchannel to input subchannel activity on a duplex channel while in IW mode. Issuing IW requests to input subchannels of duplex channels is a null operation. Meaningful IW requests must be issued to the output subchannels of duplex channels.

Internal Wraparound mode is not available on duplex channels configured within the system as half-duplex. Issuing requests with both WRP and RWR set or both WRP and RWR reset results in a null IW channel state change. IW requests that ask for the current Internal Wraparound state (enable when already enabled or disable when already disabled) are null operations.

The MAX IV system is responsible for proper exiting of tasks which abort abnormally. It is, therefore, responsible for assuring that output subchannels of duplex channels in IW mode are returned to normal transfer states when a task aborts. In order that this may be accomplished, the user must take exclusive use of the output channel associated with a full-duplex pair before IW mode can be utilized. It is highly suggested that the user take exclusive use of the input channel also. Exclusive use of both channels should be given up upon completion of IW operations.

Tasks using the IW enhancement are required to return communications lines to normal transfer states upon gracefully exiting the system. Since the tasks using this mechanism are privileged, they are responsible for such an action. However, the system forces all devices under exclusive use by a task to be automatically given up when a task exits the system. When exclusive use is given up on an output subchannel that is in IW mode, Internal Wraparound is automatically disabled as if the user had issued a HOME Request to exit Internal Wraparound Mode.

A line disconnection may also be forced by issuing a REX HOME service to the half/full-duplex channel. The request may be issued to either channel when a full-duplex line is being disconnected. The function performed by the handler will be the same as if the handler had detected an actual line disconnection except that Line Disconnect Delay Support, if optioned, is not performed. (Refer to the RING DETECT SUPPORT section of this chapter for more information.)

3.6.3 NULL OPERATIONS

The following operations do not apply to the BISYNC Handler and are treated as NULL operations:

REWIND
BACKSPACE FILE
BACKSPACE RECORD
ADVANCE RECORD
ADVANCE FILE
WEOF

3.6.4 SUMMARY TABLES

Bisynchronous Handlers summary tables appear at the end of this chapter. Tables 3-1 and 3-2 contain information about the handler's response to I/O operations in the 8 modes of data transfer. Table 3-3 lists the error and event bits in the UFT status word (UFTSTA). Conditions causing the error or event are also listed.

3.7 RING DETECT SUPPORT

Ring Detect Support provides a useful interface to auto-answer modems. Ring Detect is supported by each of the three Bisync Handlers (BI.HAN, BI7.HA, and SY7.HA), with the following MODCOMP Communications Controllers: 4804, 1907, 1907A, 1907B, and 1908.

When ring is detected, Data Terminal Ready is enabled if not enabled already and the outside world is notified of the event by enqueuing a packet (containing line connect event information) to TMP (or other line monitoring task). If a line disconnection occurs, Data Terminal Ready is disabled.

3.7.1 LINE DISCONNECTION

A line disconnection sequence is executed for the following conditions:

- An output channel hardware malfunction occurs during a WRITE operation.
- An input channel hardware malfunction occurs during a READ operation.
- DSR drops while either the input or output channel are inactive.

The above conditions are expected to handle most line disconnections. Due to the unique nature of select modems, a small percentage of disconnections will go unnoticed. However, an intelligent task may be able to determine that a line has been disconnected due to its unique communication protocol, for example, a LOGOFF in a TSX environment. In these cases, the task may issue a software requested line disconnection (refer to the REX HOME Service).

3.7.2 AUTO TASK LINE CONNECT/DISCONNECT

Auto Task Line Connect Support (LINEMONITOR option CONN) and Auto Task Line Disconnect Support (LINEMONITOR option DISC) cause the system supplied line monitor task (TMP) to perform one additional function (other than the required functions to setup support) as defined below:

- Auto Task Line Connect Support causes TMP to Establish and Activate the current attentive task.
- Auto Task Line Disconnect Support causes TMP to Deestablish and Kill the current attentive task.

Both of these options require that Ring Support (RING) also be optioned.

3.7.3 LINE DISCONNECT DELAY

Line Disconnect Delay Support (LINEMONITOR option DELAY) forces a delay between the time a line disconnect is detected and the handlers normal action associated with such an event. When the delay interval expires, the handler will discard the event if a line connect has since occurred. This support requires that Ring Support (RING) also be optioned.

LINE CONDITION EVENT	LINE MONITOR OPTIONS			ACTION
	ON	OFF	DO NOT CARE	
RING	RING	CONN	DISC	1. Call User Hook Routine (U$COMM) 2. Continue/Bypass normal function
RING	RING CONN		DISC	1. Call User Hook Routine (U$COMM) 2. Activate the attentive task 3. Continue/Bypass normal function
RING		RING CONN	DISC	No Action
HANG	RING	DISC	CONN	1. Call User Hook Routine (U$COMM) 2. Continue/Bypass normal function
HANG	RING DISC		CONN	1. Call User Hook Routine (U$COMM) 2. Deestablish/Kill attentive task 3. Continue/Bypass normal function

Figure 3-5. Control Ring Events

Figure 3-5 shows how Ring Detect Support allows the user to tailor the communications environment to suit unique needs and how the user gains control over each ring event that occurs. (Refer to TMP documentation concerning the use of the U$COMM User Hook in the MAX IV General Operating System, System Guide Manual and the MAX IV Data Structures, System Design Manual.)

3.8 SYSTEM GENERATION

3.8.1 COMCONTROLLER

The COMCONTROLLER statement must be specified for each communications line to be used in your MAX IV system. One PDT (Physical Device Table) is generated for each statement specified and for each group of statements specifying the same group and unit, a multiplexor table and appropriate driver code are generated. Additionally, this statement causes the appropriate device handler to be included in your system during the link-edit phase of system generation.

SYNTAX

```
                          1   2    3      4       5     6    7    8
COMCON[TROLLER]  hxx,#gu,chnl{,TIMED }[,fdc][,fdn],cls[,NET]
                             {,VACANT}
```

hxx - Parameter 1 is the communications controller channel name and must be unique to all controller names specified, where:

h = S for Synchronous Lines.
xx = Any unique CAN-code character pair.

#gu - Parameter 2 is the even group and unit number concatenated into one hexadecimal quantity for this controller.

chnl - Parameter 3 is the 3-character controller channel number. For half-duplex, a COMCONTROLLER statement is required for each even numbered channel; for full-duplex, separate COMCONTROLLER statements are required for each output (even) and input (odd) channel.

{TIMED}
{VACANT} - Parameter 4 determines whether this controller is timed. All synchronous controllers must be timed. The default value for this parameter should not be used. VACANT specifies that this channel is to be skipped and leaves a hole in the multiplexor table. If VACANT is specified, parameters 1, 2, 3, 4, and 7 are the only parameters evaluated.

[fdc] - Parameter 5 is used only for full-duplex channels. It specifies the channel number of the half-duplex channel to be used in conjunction with this one to configure a full-duplex pair: the mate.

[fdn] - Parameter 6 is used only for full-duplex channels. It specifies the controller name, as specified in Parameter 1, of the "mate" (see description of Parameter 5).

cls - Parameter 7 specifies the controller class. Enter one of the following letters to identify the class of your controller:

HANDLER	CLASS	MODEL NUMBER
BI.HAN	A =	4810,4811,4812,4813,1905
BI.HAN	B =	4815,4817
BI.HAN	C =	1906
BI.HAN	D =	4804,4808,4858,1907,1907A,1907B,1908(DI)
BI7.HA	E =	1907,1907A,1907B(DMI)
SY7.HA	F =	1907,1907A,1907B,1908(DMI)

[NET] - Parameter 8 is a keyword used to specify to the system that this channel will be used as a CPU link by the MAXNET symbiont.

3.8.2 COMDEVICE

One or more COMDEVICE statements are required for each COMCONTROLLER statement specified in your MAX IV system. The expansion of this macro creates a logical device table entry (LDT) and establishes a fixed assignment of that logical device to a physical device (PDT).

SYNTAX

```
                 1   2    3       4          5           6
    COMDEVICE   dxx,hxx[,bpr][,options][,exclutask ][,watchdog]
                                        [,-influence]

                     7       8          13
                [,chrsiz][,parity],,,,,sync
```

dxx - Parameter 1 is the logical device name and must be unique to all device names specified (communications channels), where:

d = S for Synchronous devices.
xx = Any unique CAN-code character pair.

hxx - Parameter 2 is the name of the communications controller to which this logical device is connected (see COMCONTROLLER statement).

[bpr] - Parameter 3 is the maximum bytes per record that this device accepts (0-256). If zero is specified, the record size is considered "unlimited".

[options] - Parameter 4 permits modification of the contents of the logical device characteristics word in the data structure (LDT) for this device. It specifies certain options that may be examined by the specific handler when a handler supports many similar but not identical types of devices. Enabling Bit 6 of the input LDT option word allows for 16 Bit CRC support on BISYNC input requests handled by BI.HAN. Enabling Bit 7 of the input LDT option word will cause the handler to detect #10 #83 as DLE ETX on input, store #10 #83 in the user's buffer and terminate after BCC is stored. This option is for BI.HAN BISYNC TRANSPARENCY mode only. Terminations only occur when an odd number of DLE's are detected before the ETX character.

[exclutask]
[-influence] - Parameter 5 is optional. It specifies either a task name or a negative influence limit. If a task name is given, the designated task is given permanent exclusive use of the device to the complete exclusion of all other tasks.

If a negative influence limit number in the range of -000 or -255 is given, then only tasks that have an influence limit number with absolute value less than or equal to the absolute value of this parameter are permitted to use this logical device. The default is a negative influence limit number of -255.

[watchdog] - Parameter 6 is the maximum time in basic clock interrupt periods that an operation to this device will be allowed to stay at the head of the queue of its controller. If not specified, a default value appropriate to the type of device is assigned. (See Section 3.3, TIMER OPTION.)

[chrsiz] - Parameter 7 specifies the data character (frame) size (in bits) and may be specified as 5, 6, 7 or 8. This value is the actual number of bits transferred from/to memory; the default is 8.

[parity] - Parameter 8 is a keyword specifying the parity and may take on the following values:

EVEN for even parity,
ODD for odd parity or,
NONE for no parity (default).

Character parity, when specified, is generated and checked by the channel hardware. ASCII terminals that have the parity bit as always a space (Ø) should normally specify the character size as 8 and the parity as NONE. ASCII terminals that have the parity bit as always a mark (1) should change the parity option in the terminal to a space, odd or even parity.

- Parameters 9, 10, 11, and 12 should be defaulted for the Bisync Handler.

sync - Parameter 13 is required for synchronous lines on the 1907 controller only, and specifies the sync character to be used expressed as a HEX character pair (#16 for ASCII or #32 for EBCDIC). The default is #ØØ.

3.8.3 LINEMONITOR

DEFINE COMMUNICATION LINE MONITORING CHARACTERISTICS

One LINEMONITOR statement is optional and is used only if a Ring processing task is to be included in the system. This statement is required for each communications line for which Ring will be queued to some line monitoring support task. One such task is supplied by MODCOMP to provide for Auto Answer support (this task is called the Terminal Monitor Program - TMP); however, any number of user tasks may also exist in the system.

SYNTAX

```
                  1       2          3         4          5         6
    LINEMON   output[,input][,options][,task][,prefix][,delay]
```

output - Parameter 1 is the logical device name on which RING and LINE DISCONNECT are to be detected. If the device is a full-duplex device, "output" is the name of the device on the output channel.

[input] - Parameter 2 is only required if the device is a full-duplex device. If the device is half-duplex, either this parameter must not be entered or must be entered the same as Parameter 1. If the device on which RING and LINE DISCONNECT are to be detected is a full-duplex device, "input" is the logical device name of the device connected to the input channel.

[options] - Parameter 3 is optional. It specifies line monitoring characteristics as follows:

Ring Support	RING	(#1000)
Auto Task Line Connect Support	CONN	(#0800)
Auto Task Line Disconnect Support	DISC	(#0400)
Line Disconnect Delay Support	DELAY	(#0200)

Auto Task Line Connect Support, Auto Task Line Disconnect Support, and Line Disconnect Delay Support require that Ring Support be optioned. The default option is no Ring support.

[task] - Parameter 4 is optional. It specifies the task name that is to be notified (by a packet queued to it) when a RING or LINE DISCONNECT is detected from the supported device. All these task names must be only 3 characters long. The default task name is TMP (Terminal Monitor Program).

[prefix] - Parameter 5 is optional. It specifies a three character CAN-codable task name prefix to be used as the prefix to the initial attentive task name. The 3-character suffix to the task name will be the line number in decimal ASCII. A line number is based on the LINEMONITOR statement ordering. The line number of the first LINEMONITOR statement is "001". The line number of each additional statement is "002", "003", et cetera. If this parameter is not supplied then there will be no initial attentive task name.

[delay] - Parameter 6 is optional. It specifies the number of ticks to delay after detecting a line disconnection. The time delay operates at low clock level. This parameter is used in conjunction with Line Disconnect Delay Support (DELAY) only and the default delay is 3 seconds or 600 ticks.

3.8.4 SYSGEN STATEMENT EXAMPLES

```
COMCONTROLLER     S00,#1A,000,TIMED,001,S01,B
COMCONTROLLER     S01,#1A,001,TIMED,000,S00,B
```

Define a full-duplex synchronous channel (PDT) for a 4815 type controller at addresses #1A and #1B.

```
COMCON     S02,#1A,002,TIMED,003,S03,B
COMCON     S03,#1A,003,TIMED,002,S02,B
```

Define a second full-duplex synchronous channel on the same controller. These controllers are always timed.

```
COMDEVICE     S00,S00,,,,,8,NONE
COMDEVICE     S01,S01,,,,,8,NONE
```

Define a full-duplex logical device (synchronous channel) for device addresses #1A and #1B using the channels 000 and 001 as defined on the COMCONTROLLER statements for "S00" and "S01" above. This duplex channel is configured for use with the 2780 or 3780 Emulators.

```
COMDEV     S02,S02,,,,,7,ODD
COMDEV     S03,S03,,,,,7,ODD
```

Define a second duplex synchronous channel in conjunction with the COMCONTROLLER statements for "S02" and "S03" above. Logical device S02 and S03 are defined for use with the 200 User Terminal Emulator.

```
LINEMONITOR     S00,S01,RING,TMP
```

Specify a full-duplex device with ring support.

```
LINEMO     S02,,RING,TMP
```

Specify a half-duplex device.

```
LINEMO     S04,S05,RING,TMP,BAT
```

Specify a full-duplex device with ring support. The attentive task name is BAT001.

```
LINEMO     S06,,RING+CONN+DISC+DELAY,TMP,BAT,600
```

Specify all supported options and a disconnect delay of 600 ticks.

	ASCII MODES		BINARY MODES	
	STANDARD	NON-STANDARD	STANDARD	NON-STANDARD
0 READ	INPUT ONE RECORD FROM SYCHRONOUS DEVICE. TERMINATOR= CR OR NUL. IGNORE ALL LF. IGNORE LEADING CR AND NUL. IGNORE TRAILING BACKSPACE & RUBOUT.	INPUT ONE RECORD FROM SYNCHRONOUS DEVICE. NUL BYTES ARE BYPASSED AS LEADER, OTHERWISE THEY TERMINATE THE RECORD. ANY OTHER TERMINATOR MAY BE SELECTED BY USER AND PLACED IN OPTION WORD.	INPUT ONE RECORD FROM SYNCHRONOUS DEVICE, TERMINATING ON EXPIRATION OF BYTE COUNT. LEADER IS IGNORED AS WELL AS LEADING CR AND LF.	<-----SAME
1 WRITE	OUTPUT ONE RECORD FROM USER'S BUFFER TO SYNCHRONOUS DEVICE, TERMINATING ON EXPIRATION OF OF BYTE COUNT OR NUL CHARACTER DETECTION.	OUTPUT ONE RECORD FROM USER'S BUFFER TO SYNCHRONOUS DEVICE, TERMINATING ON EXPIRATION OF BYTE COUNT OR USER SPECIFIED TERMINATOR.	OUTPUT ONE RECORD FROM USER'S BUFFER TO SYNCHRONOUS DEVICE, TERMINATION OF EXPIRATION OF RECORD, OR USER SPECIFIED BYTE COUNT.	OUTPUT ONE RECORD FROM USER'S BUFFER TO SYNCHRONOUS DEVICE, TERMINATING OF EXPIRATION OF USER SPECIFIED BYTE COUNT.
2 REWIND	null	<-----SAME	<-----SAME	<-----SAME
3 BKFILE	null	<-----SAME	<-----SAME	<-----SAME
4 BKRECORD	null	<-----SAME	<-----SAME	<-----SAME
5 AVRECORD	null	<-----SAME	<-----SAME	<-----SAME
6 AVFILE	null	<-----SAME	<-----SAME	<-----SAME
7 WEOF	null	<-----SAME	<-----SAME	<-----SAME
8 HOME	USED FOR INTERNAL WRAPAROUND, RESET DATA-TERMINAL-READY AND/OR LINE DISCONNECTION REQUESTS.	<-----SAME	<-----SAME	<-----SAME
9 TAKE	TAKE EXCLUSIVE USE.	<-----SAME	<-----SAME	<-----SAME
10 GIVE	GIVE UP EXCLUSIVE USE.	<-----SAME	<-----SAME	<----SAME

Table 3-1. Bisynchronous
Communications Operations and Modes (STANDARD)

	ASCII		EBCDIC	
	FORMATTED	FIXED LENGTH	FORMATTED	FIXED LENGTH
0 READ	INPUT ONE BISYNC BLOCK; TERMINATING ON EXPIRATION OF BYTE COUNT OR TERMINATOR CONTROL CHARACTER IS RECOGNIZED.	INPUT ONE BLOCK FROM BISYNC DEVICE, TERMINATING ON EXPIRATION OF BYTE COUNT.	SAME AS FORMATTED ASCII READ	SAME AS FIXED LENGTH ASCII READ.
1 WRITE	USER SPECIFIED NUMBER BYTES WILL BE TRANSMITTED TO BISYNC DEVICE. LAST DATA CHARACTER FOLLOWED BY PAD CHARACTER.	<-----SAME	<-----SAME	<-----SAME
2 REWIND	null	<-----SAME	<-----SAME	<-----SAME
3 BKFILE	null	<-----SAME	<-----SAME	<-----SAME
4 BKRECORD	null	<-----SAME	<-----SAME	<-----SAME
5 AVRECORD	null	<-----SAME	<-----SAME	<----SAME
6 AVFILE	null	<-----SAME	<-----SAME	<-----SAME
7 WEOF	null	<-----SAME	<-----SAME	<-----SAME
8 HOME	USED FOR INTERNAL WRAPAROUND, RESET DATA-TERMINAL-READY, AND/OR LINE DISCONNECTION REQUESTS	<-----SAME	<----SAME	<-----SAME
9 TAKE	TAKE EXCLUSIVE USE.	<-----SAME	<----SAME	<----SAME
10 GIVE	GIVE UP EXCLUSIVE USE.	<-----SAME	<-----SAME	<-----SAME

Table 3-2. Bisynchronous Communications Operations and Modes (BISYNC)

PROGRAMMER'S ERROR/EVENT BIT IN UFT UFTSTA	OPERATOR'S REASON CODE	REASON FOR ERROR/EVENT IF SET
1	OVF	CHANNEL OVERFLOW OR UNDERFLOW
2	PAR	INPUT CHANNEL PARITY ERROR
3	INO	-DEVICE DOES NOT EXIST -DEVICE INOPERABLE (POWER OFF) -WATCHDOG TIMER EXPIRATION
4	MPE	CP DETECTED MPE ON DMI TRANSFER
5	LOK	MALFUNCTION
6	CIG	INPUT CHANNEL: FRAME ERROR OUTPUT CHANNEL: RING CONDITION DETECTED
7	OTH	-NONE-
8	HOL	-NONE-
9	EOM END-OF-MEDIUM MEDIUM	-PAPER SUPPLY EXPIRED -OPERATOR SHOULD PUT DEVICE OFFLINE, REPLACE PAPER SUPPLY AND PUT DEVICE ON LINE.
10	EOF END-OF-FILE	-CARRIAGE PRINTED LAST LINE IN END-OF-FORM MARGIN -SET AFTER REWIND OR NULL OPERATIONS.
11	BOM BEGINNING-OF-MEDIUM	-SET AFTER REWIND OR NULL OPERATIONS

Table 3-3. Bisynchronous Communications Errors and Events

CHAPTER 4
MAX IV SDLC/HDLC FRAME HANDLER

SDLC (SYNCHRONOUS DATA LINK CONTROL) protocol was introduced by IBM in 1969. HDLC, or (HIGH-LEVEL DATA LINK CONTROL) is a standard proposed by the International Standardization Organization (ISO). Both protocols are bit-oriented and have similar frame formats. The only major differences between the two is the HDLC capability to have extended address and control fields.

ADCCP (ADVANCED DATA COMMUNICATIONS CONTROL PROCEDURE) is a protocol standard proposed by ANSI and it is equivalent to the HDLC protocol; therefore, these channels will also support ADCCP.

The SDLC/HDLC Frame handler (DLC.HA) is designed to run on a CLASSIC under the supervision of a MAX IV Operating System. The following communication controllers, along with their associated HDLC/SDLC Interfaces, are supported:

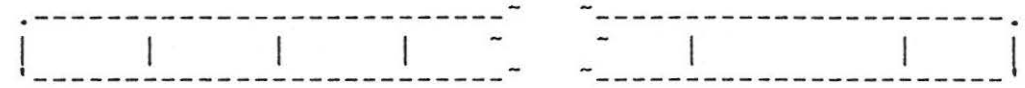
1907A/1907B:	1937 - HDLC/SDLC	RS232 Interface
	1938 - HDLC/SDLC	Wide Band Interface
	1939-1 - HDLC/SDLC	RS232 Interface
	1939-2 - HDLC/SDLC	Wide Band Interface
	1939-3 - HDLC/SDLC	V35 Interface
1908	1909-3 - HDLC/SDLC	RS232 Interface
	1909-4 - HDLC/SDLC	Wide Band Interface
	1909-5 - HDLC/SDLC	V35 Interface

The handler's function is to perform Input/Output data transfers on behalf of a calling task according to the rules of protocol for SDLC/HDLC. It is designed to be a frame-level handler, and it relies upon the calling task to provide protocol logic.

The SDLC/HDLC Frame handler works in DMI mode with a Communications Processor. Interrupt and Transfer (DI) mode is also supported by this handler. The SDLC/HDLC frame level handler supports half- and full-duplex modes of operation.

4.1 FRAME DEFINITION

This handler provides a MAX IV user with a frame-level interface to support SDLC/HDLC protocol. A frame is defined as a sequence of contiguous bits, bracketed by beginning and ending flag sequences. A valid frame is at least 32 bits in length and contains an address field, a control field and a frame check sequence. A frame may or may not include an Information field. A flag sequence is a unique sequence of 8 bits ('01111110') employed to delimit the beginning and ending of a frame. A typical SDLC frame is shown in Figure 4-1.



FIELD NAME:	FLAG	ADDRESS	CONTROL	INFORMATION	FRAME CHECK SEQUENCE	FLAG
ABBREVIATION:	F	A	C	I	FCS	F
BIT LENGTH:	8	8	8	variable	16	8

Figure 4-1. Typical SDLC Frame

The information that is passed from the user task to the handler and vice versa is contained in the A, C, and I fields.

The SDLC/HDLC communication channel provides the capability of interfacing the Integrated/Universal Communications Controller and Communications Processor (if DMI mode) to communications lines that use the SDLC/HDLC protocol. The SDLC/HDLC communication channel board has two full-duplex channels. Each full-duplex channel consists of an output and input channel.

4.2 OPERATIONS AND MODES

This handler supports seven REX functions:

REWIND
HOME
READ
WRITE
TERMINATE
TAKE
GIVE

All REX functions support quick return and wait mode options. The Standard MAX IV I/O call and return conventions apply.

The handler makes no distinction between Standard ASCII, Non-Standard ASCII. Standard Binary, and Non-Standard Binary. The handler processes byte strings without checking for any special characters.

When the SDLC/HDLC channels are specified at SYSGEN time, several options are available that control line characteristics. The user may specify Transmitter and Receiver (information field) lengths of 5, 6, 7 or 8 bits per character. A secondary address may be specified but is not enabled until a REX REWIND (#2) is issued requesting a Load Secondary Address.

4.3 TIMER SERVICES

In order to implement watchdog timers for I/O requests using this handler, the user must do the following:

- Specify the TIMED parameter in the SYSGEN COMCONTROLLER statement. This causes the PDT to be threaded into the list of timed controllers.

- Specify the watchdog parameter in the SYSGEN COMDEVICE statement. This provides a default number of system ticks as a timer value.

- If a timer value other than the default is required, the user may supply that value in system ticks in register 3 when the REX call is made. The user must also set the UST bit in the UFT Extended Option Word XUFOPT. When UST is equal to 1, it indicates that the timer value is specified in register 3. When the UST bit reset (equal 0), the SYSGENed value is used for the timer.

4.4 REWIND

The REWIND REX service is used by the SDLC/HDLC Frame handler to initialize an SDLC/HDLC Channel. The control information options are selected by setting bits in the Extended UFT Option Word XUFOPT.

No data is transferred by a REWIND request; only mode options are selected. The normal status return from a REWIND is both End-of-File (EOF) and Beginning of Medium (BOM) bits set in UFTSTA. REWIND requests should be issued to both the input channel and the output channel.

SYSGEN allows the user to specify only the receiver length, transmitter length, and secondary address. When the system is initially loaded, the following is true:

```
STATION IS PRIMARY
NON-EXTENDED ADDRESS MODE
NON-EXTENDED CONTROL MODE
NON-GLOBAL
IDLE IN MARK
```

The user cam change these conditions by setting option bits in the Extended UFT Option Word and issuing a REX REWIND to both the input channel and the output channel. The option bits are shown in Figure 4-2.

4.4.1 REQUEST TO SEND - BIT 7 - RTS

Dynamic control of the Request-to-Send (RTS) modem signal is supported. The user can have RTS toggle between output transmissions or request that RTS remain enabled until further notice. The initial system start-up state is defined at SYSGEN. Bit 7 in UFT word XUFOPT is used to convey the users dynamic request as follows:

B7 set - RTS is to remain enabled after the next output request until further notice.

B7 reset - The RTS signal is to be enabled at the startup of an output request and disabled at the completion of the same request.

The default case is defined as having RTS toggle between output requests so that system software revision up-grades do not alter the previous operating state. Request-to-Send Dynamic control mode requests must be issued to the output channel and can be issued at any time whether other mode options are specified or not. Request-to-Send Dynamic control is interrogated and programmed by the handler on each receipt of a REWIND request and as such users must take this into consideration when preparing UFT's associated with REWIND requests.

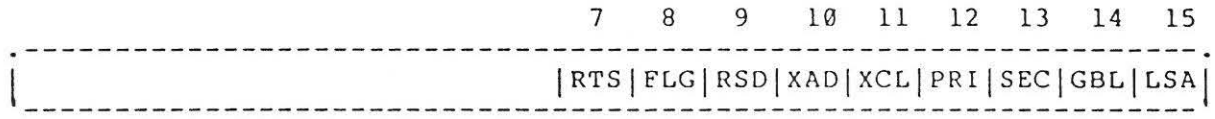


Figure 4-2. Extended UFT Option Word (XUFOPT)

BIT	NAME	MEANING WITH A REWIND
8	FLG	= Ø Causes idle to occur in mark mode. = 1 Causes idle to occur in flag mode.
9	RSD	= 1 Reset the data terminal ready signal.
10	XAD	= 1 Select the extended address mode.
11	XCL	= 1 Select the extended control mode.
12	PRI	= 1 Select the primary station.
13	SEC	= 1 Select the secondary station.
14	GBL	= 1 Select the global addressing mode.
15	LSA	= 1 To load the secondary address from the LDT.

4.5 HOME

The HOME REX service is used by the SDLC/HDLC Frame Handler to issue Internal Wraparound (IW) requests. Requesting tasks must be privileged and should understand the ramifications of exercising Internal Wraparound on a duplex channel. The privileged state is required whether the user is enabling or disabling Internal Wraparound.

Only REX HOME services issued to the output channel (even numbered channel) affect IW states. The options are specified by the device dependent bits (8 through 15) of the Extended Option Word (XUFOPT) of the UFT.

Bit 10 - WRP - Enter Internal Wrap

Bit 11 - RWR - Reset Internal Wrap

Internal Wraparound (IW) support allows the output subchannel of a duplex channel to transmit to the input subchannel of the same duplex channel. While a duplex channel is in Internal Wraparound mode. The following functions are disabled:

- Break key support (not available on the 481X controllers)
- Break character support
- Echoplex handling
- External transmitting of data

IW loops transmit data back to receive data and forces a mark condition to the modem/line interface.

The user is responsible for output-subchannel-to-input-subchannel activity on a duplex channel while in IW mode. Issuing IW requests to input subchannels of duplex channels is a null operation. Meaningful IW requests must be issued to the output subchannels of duplex channels.

Internal Wraparound mode is not available on duplex channels configured within the system as half-duplex. Issuing requests with both WRP and RWR set or both WRP and RWR reset results in a null IW channel state change. IW requests that ask for the current internal wraparound state (enable when already enabled or disable when already disabled) are null operations.

4.5.1 EXCLUSIVE USE

The MAX IV system is responsible for proper exiting of tasks that abort abnormally. It is, therefore, responsible for assuring that output subchannels of duplex channels in IW mode are returned to normal transfer states when a task aborts. In order that this may be accomplished, the user must take exclusive use of the output channel associated with a full-duplex pair before IW mode can be utilized. It is highly suggested that the user take exclusive use of the input channel also. Exclusive use of both channels should be given up upon completion of IW operations.

4.5.2 EXITING IW

Tasks using the IW enhancement are required to return communications lines to normal transfer states upon gracefully exiting the system. Since the tasks using this mechanism are privileged, they are responsible for such an action. However, the system forces all devices under exclusive use by a task to be automatically given up when a task exits the system. When exclusive use is given up on an output subchannel that is in IW mode, Internal Wraparound is automatically disabled as if the user had issued a HOME Request to exit Internal Wraparound Mode.

4.5.3 LINE DISCONNECT

A line disconnection may be forced by issuing a REX HOME service to the half/full-duplex channel. The request may be issued to either channel when a full-duplex line is being disconnected. The option is defined by the device dependent bits (8 through 15) of the extended option word (XUFOPT) of the UFT.

Bit 12 - DCL - Disconnect Line

The function performed by the handler will be the same as if the handler had detected an actual line disconnection except that Line Disconnect Delay Support, if optioned, is not performed. (Refer to the RING DETECT SUPPORT section of this chapter for more information.)

4.6 READ

A start-of-buffer address and a byte count are required as per standard MAX IV I/O calls. System error recovery is optionally provided. All READ requests (including those that encounter errors) will be returned to the user if system error recovery is not specified. When the READ is marked completed, that is, when the Buffer Busy (BB) bit and UFT Busy (UB) bits are reset, UFTBCT will contain the total number of bytes read.

If the logical device to which the READ is directed is in primary mode, extended address, or extended control, the next frame, properly bound by flags, will be passed to the user's read buffer. If the logical device is a secondary station, not extended address and not extended control, then the receive will only be completed by frames with the correct secondary address. If the secondary station is a global secondary, it will also receive frames with the global address #FF. Refer to Figure 4-3.

The SDLC/HDLC handler, at the completion interrupt of a READ, will open the next READ on the queue, if present, to receive consecutive frames. There is a small amount of setup time necessary to accomplish this and, therefore, at higher baud rates the receiver may not be enabled in time. Also, due to the Communications Processor automatically terminating on EOB, READ requests cannot be allowed to complete to EOB if consecutive frames are to be received. The user task should specify a byte count one greater than expected to receive consecutive frames.

RECEIVER STATION MODES: \ FRAME ADDRESS FIELD CONTENTS:	= Station Address	NOT EQUAL Station Address	=#FF Global Address
Primary	R	R	R
Secondary Non-Extended Address & Control	R	I	I
Global Secondary Non-Extended Address & Control	R	I	R
Extended Address or Extended Control (Primary or Secondary)	R	R	R

where: R = Received
I = Ignored

Figure 4-3. READ Request Response

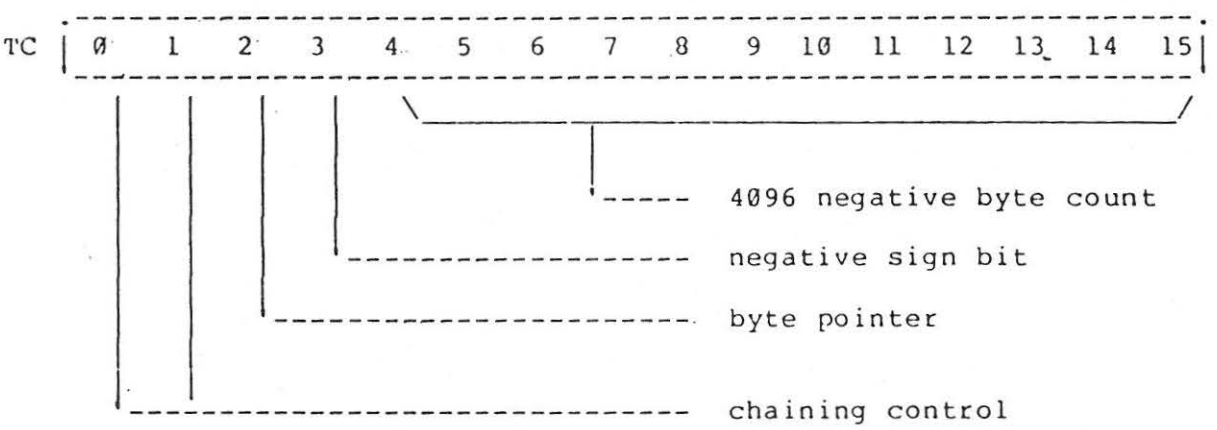
4.6.1 RECEIVER DATA CHAINING

To specify receiver data chaining the user must supply the address of the chain list in UFT Word 8 (XUFBUF), or optionally in R14 as in standard I/O calls. The user must set Bit 1 of UFT Word 9 (XUFCNT), or optionally in R15, to indicate XUFBUF is an address of a chain list.

The format of the chain list is as follows:

```
TC          (CONTINUE IN THIS LIST)
TA          (ADDRESS OF BUFFER)
TC          (CONTINUE IN THIS LIST)
TA          (ADDRESS OF BUFFER)
TC          (LAST ENTRY OF CHAIN LIST)
TA          (ADDRESS OF BUFFER)
```

The format of the transfer count word is explained in Figure 4-4.



Bit 0,1 =

'01 - Data chaining when byte count is exhausted. Use next TC/TA pair.

'11 - Last block.

Bit 2 - Byte pointer. This bit points to the next byte to be transferred. 1=left byte. 0=right byte.

Figure 4-4. Transfer Count (TC) Format

The user will be aborted with the reason code 'DI CHN' if attempting to use data chaining in DI mode under system recovery.

4.6.2 RECEIVER DATA CHAIN EXAMPLE

The following example shows a data chaining UFT and associated chain list. The list is set up to accomplish the following:

```
  1 BYTE INTO RIGHT BYTE OF RC1.A
  1 BYTE INTO RIGHT BYTE OF RC1.C
510 BYTES INTO LEFT BYTE OF RC1.I
  1 BYTE INTO RIGHT BYTE OF RC1.D
```

```
*
* DATA CHAIN UFT
*
RC1     DFC     0,@RCV,#8000,0,0,0,#0485,0,RC1.DC,#4000
*
*
*
R       EQU     0               RIGHT BYTE
L       EQU     1               LEFT BYTE
*
DMI.TC  DFF     2,1,13          DMI TC FORMAT
*
RC1.DC  EQU     $
        DMI.TC  1,R,-1          0-TC    1 BYTE
        DFC     RC1.A           1-TA    ADDRESS
        DMI.TC  1,R,-1          2-TC    1 BYTE
        DFC     RC1.C           3-TA    CONTROL
        DMI.TC  1,L,-510        4-TC    510 BYTES
        DFC     RC1.I           5-TA    INFO
        DMI.TC  3,R,-1          6-TC    1 BYTE
        DFC     RC1.D           7-TA    DUMMY

RC1.A   DFC     0               ADDRESS FIELD BUFFER
RC1.C   DFC     0               CONTROL FIELD BUFFER
RC1.I   RES     255             INFORMATION FIELD BUFFER
RC1.D   DFC     0               DUMMY BUFFER
```

4.6.3 RECEIVER DATA CHAINING COMPLETION

At the completion of a receiver data chaining operation, Bits 8-15 of UFT Word 2 (UFTOPT) will contain the number of buffers into which data was transferred. Additionally, UFT Word 4 (UFTBCT) will be equal to the number of bytes in the last buffer if it was only partially filled. If the last buffer to receive data was filled to end of block, UFTBCT will be equal to zero.

4.7 WRITE

A start-of-buffer address and a transfer byte count are required as per standard MAX IV I/O calls. System error recovery is optionally provided. All WRITE requests, including those that encounter errors, will be returned to the user if System error recovery is not specified. When the WRITE is marked complete (BB & UB reset), UFTBCT will contain the total number of bytes written. A single frame is written for each WRITE issued.

4.7.1 TRANSMIT ABORT

The function of prematurely terminating a data link is called 'transmit abort'. This function is reserved to the transmitter under SDLC/HDLC procedures. The transmitting station aborts by sending eight consecutive binary ones.

Condition when transmit abort is issued by the hardware:

UNDERRUN ON THE TRANSMITTER

Condition when transmit abort is issued by the software (HANDLER):

MEMORY PARITY ERROR ON THE TRANSMITTER
REX TERMINATE OF THE ACTIVE NODE ON TRANSMITTER

Due to an idiosyncrasy of the channel, a frame size specification of other than eight causes the handler to output address and control information in the DI mode. Data (text) following the address and control fields will be output in the DMI mode.

4.8 TERMINATE

A REX TERMINATE of an active node on a transmitting channel will result in a transmit abort being issued by the transmitting channel. A REX TERMINATE of an active node on a receiving channel will result in the receiver operation being terminated.

4.9 TAKE,GIVE

The handler supports TAKE Exclusive Use and GIVE Exclusive Use according to standard procedures.

4.10 RING DETECT SUPPORT

Ring Detect Support provides a useful interface to auto-answer modems. Ring Detect is supported by DLC.HA on 1907A, 1907B, and 1908 controllers.

When ring is detected, Data Terminal Ready is enabled if not enabled already. The outside world is notified of the event by enqueuing a packet (containing line connect event information) to TMP (or other line monitoring task). If a line disconnection occurs, Data Terminal Ready is disabled.

4.10.1 LINE DISCONNECTION

A line disconnection sequence is executed for the following conditions:

- An output channel hardware malfunction occurs during a WRITE operation.
- An input channel hardware malfunction occurs during a READ operation.
- DSR drops while either the input or output channel are inactive.

The above conditions are expected to handle most line disconnections. Due to the unique nature of select modems, a small percentage of disconnections will go unnoticed. However, an intelligent task may be able to determine that a line has been disconnected due to its unique communication protocol, for example, a LOGOFF in a TSX environment. In these cases, the task may issue a software requested line disconnection (refer to the REX HOME Service).

4.10.2 AUTO TASK LINE CONNECT/DISCONNECT

Auto Task Line Connect Support (LINEMONITOR option CONN) and Auto Task Line Disconnect Support (LINEMONITOR option DISC) cause the system supplied line monitor task (TMP) to perform one additional function (other than the required functions to setup support) as defined below:

- Auto Task Line Connect Support causes TMP to Establish and Activate the current attentive task.
- Auto Task Line Disconnect Support causes TMP to Deestablish and Kill the current attentive task.

Both of these options require that Ring Support (RING) also be optioned.

4.10.3 LINE DISCONNECT DELAY

Line Disconnect Delay Support (LINEMONITOR option DELAY) forces a delay between the time a line disconnect is detected and the handlers normal action associated with such an event. When the delay interval expires, the handler will discard the event if a line connect has since occurred. This support requires that Ring Support (RING) also be optioned.

LINE CONDITION EVENT	LINE MONITOR OPTIONS			ACTION
	ON	OFF	DO NOT CARE	
RING	RING	CONN	DISC	1. Call User Hook Routine (U$COMM) 2. Continue/Bypass normal function
RING	RING CONN		DISC	1. Call User Hook Routine (U$COMM) 2. Activate the attentive task 3. Continue/Bypass normal function
RING		RING CONN	DISC	No Action
HANG	RING	DISC	CONN	1. Call User Hook Routine (U$COMM) 2. Continue/Bypass normal function
HANG	RING DISC		CONN	1. Call User Hook Routine (U$COMM) 2. Deestablish/Kill attentive task 3. Continue/Bypass normal function

Figure 4-5. Control Ring Events

Figure 4-5 shows how Ring Detect Support allows the user to tailor the communications environment to suit unique needs and how the user gains control over each ring event that occurs. (Refer to TMP documentation concerning the use of the U$COMM User Hook in the MAX IV General Operating System, System Guide Manual and the MAX IV Data Structures, System Design Manual.)

4.11 SYSTEM GENERATION

The addition of communications software to the MAX IV Basic Input/Output system has necessitated a unique approach due to the nature of the communications hardware. The channel controller and multiplexors require what amounts to a party-line within a party-line. This leads to the requirement of the COMCONTROLLER macro. Furthermore, each communications controller requires the definition of channels that are considered as simplex channels for the sake of SYSGEN. Each full-duplex channel is considered to be made up of a pair (one input, one output) of simplex channels.

The physical channels are numbered contiguously starting with zero. All even-numbered channels are the output channels of the pair; the odd-numbered channels are the input channels. Each COMCONTROLLER macro call references those physical channels that it is defined to service. A COMDEVICE macro call is required for each logical device attached to those channels. Several logical devices may be defined for a physical channel. However, those channel characteristics that are defined by the COMCONTROLLER statement are only defined once. Therefore, a physical duplex channel may be configured as one or two simplex channels, a half-duplex channel or a full-duplex channel.

4.11.1 COMCONTROLLER

DEFINE EACH COMMUNICATIONS CONTROLLER CHANNEL

The COMCONTROLLER statement must be specified for each communications line to be used in your MAX IV system. One PDT (Physical Device Table) is generated for each statement specified and for each group of statements specifying the same group and unit, a multiplexor table and appropriate driver code are generated. Additionally, this statement causes the appropriate device handler to be included in your system during the link-edit phase of system generation. The SDLC/HDLC handler requires a device class (parameter 7) of "G" or "H".

SYNTAX

```
                      1   2   3      4        5     6    7    8    9
COMCON[TROLLER] hxx,#gu,chnl,{TIMED }[,fdc][,fdn],cls[,NET][,CL]
                             {VACANT}
```

hxx - Parameter 1 is the communications controller channel name and must be unique to all controller names specified, where:

h = S for a Synchronous channel
xx = Any unique CAN-code character pair

#gu - Parameter 2 is the even group and unit number concatenated into one hexadecimal quantity for this controller.

chnl - Parameter 3 is the 3-character controller channel number. For half-duplex, a COMCONTROLLER statement is required for each even numbered channel; for full-duplex, separate COMCONTROLLER statements are required for each output (even) and input (odd) channel.

{TIMED}
{VACANT} - Parameter 4 determines whether this controller is timed. All synchronous and SDLC/HDLC channels MUST be timed. The default value for this parameter should not be used. VACANT specifies that this channel is to be skipped and leaves a hole in the multiplexor table. If VACANT is specified, parameters 1, 2, 3, 4 and 7 are the only parameters looked at.

[fdc] - Parameter 5 is used only for full-duplex channels. It specifies the channel number of the other channel to be used in conjunction with this one to configure a full-duplex pair: the mate.

[fdn] - Parameter 6 is only used for full-duplex channels. It specifies the controller name, as specified in Parameter 1, of the "mate" (see description of Parameter 5).

cls - Parameter 7 specifies the controller class. Enter either 'G' or 'H' to define the class of the controller:

G = 1907,1907A,1907B,1908(DMI)
H = 1907,1907A,1907B,1908(DI).

[NET] - Parameter 8 is a keyword used to specify to the system that this channel will be used as a CPU link by the MAXNET symbiont.

[CL] - Parameter 9 is an optional keyword used to specify that an asynchronous device has a current loop interface and is required for 1907 async channels where applicable. The default is not current loop. If, for SDLC/HDLC channels, "CL" is specified on output channels, data transmission occurs in the quick initiate mode without modem controls. Without the "CL" parameter, data transmission does not begin until data-set-ready and clear-to-send are present from the modem. Data transfers are always enabled immediately on input channels.

4.11.2 COMDEVICE

DEFINE EACH COMMUNICATIONS DEVICE IN SYSTEM'S LOGICAL DEVICE LIST

One or more COMDEVICE statements are required for each COMCONTROLLER statement specified in your MAX IV system. The expansion of this macro creates a logical device table entry (LDT) and establishes a fixed assignment of that logical device to a physical device (PDT).

SYNTAX

```
                    1   2    3        4           5            6
COMDEV[ICE]      dxx,hxx[,bpr][,options][,exclutask ][,watchdog]
                                                [,-influence]

                       7         8        9     10
                  [,chrsiz],parity,stopbits,echo
```

dxx - Parameter 1 is the logical device name and must be unique to all device names specified (communications channels), where:

d = S for Synchronous devices.
xx = Any unique CAN-code character pair.

hxx - Parameter 2 is the name of the communications controller to which this logical device is connected (see COMCONTROLLER statement).

[bpr] - Parameter 3 is the maximum bytes per record which this device accepts (0-256). If zero is specified, the record size is considered "unlimited".

[options] - Parameter 4 permits modification of the contents of the logical device characteristics word in the data structure (LDT) for this device. It specifies certain options that may be examined by the specific handler when a handler supports many similar (but not identical types of) devices. For point-to-point configurations, this parameter may be specified as #100 which causes "Request-to-Send" not to be disabled following the completion of output requests, otherwise, Request-to-Send is enabled/disabled for each output transmission. Dynamic control of this option is provided through the REWIND REX service. Point-to-Point V35 and Wide Band interfaces that do not utilize modems must specify this parameter as #100. For MAXNET options, see the MAXNET Reference Manuals.

[exclutask]
[-influence] - Parameter 5 is optional. It specifies either a task name or a negative influence limit. If a task name is given, the designated task is given permanent exclusive use of the device to the complete exclusion of all other tasks.

If a negative influence limit number in the range of -000 or -255 is given, then only tasks that have an influence limit number with absolute value less than or equal to the absolute value of this parameter are permitted to use this logical device. The default is a negative influence limit number of -255.

[watchdog] - Parameter 6 is the maximum time in basic clock interrupt periods that an operation to this device is allowed to stay at the head of the queue of its controller. If not specified, a default value appropriate to the type of device is assigned.

[chrsiz] - Parameter 7 for SDLC/HDLC, must be specified as 'DLC', and Parameters 8, 9, and 10 take on new special meanings as specified below.

parity - Parameter 8

If Parameter 7 is 'DLC', Parameter 8 specifies the data character size of the information field for the receive channel. Data character sizes of 5, 6, 7, or 8 bits may be specified.

stopbits - Parameter 9

If Parameter 7 is 'DLC', Parameter 9 specifies the data character size of the information field for the output channel. Data character sizes of 5, 6, 7, or 8 bits may be specified.

echo - Parameter 10

If Parameter 7 is 'DLC', Parameter 10 specifies the first octet of the secondary address.

4.11.3 LINEMONITOR

DEFINE COMMUNICATION LINE MONITORING CHARACTERISTICS

One LINEMONITOR statement is optional and is used only if a Ring processing task is to be included in the system. This statement is required for each communications line for which Ring is queued to some line monitoring support task. One such task is supplied by MODCOMP to provide for Auto Answer support (this task is called the Terminal Monitor Program - TMP); however, any number of user tasks may also exist in the system.

SYNTAX

```
                    1       2          3         4          5         6
     LINEMON    output[,input][,options][,task][,prefix][,delay]
```

output - Parameter 1 is the logical device name on which RING and LINE DISCONNECT are to be detected. If the device is a full-duplex device, "output" is the name of the device on the output channel.

[input] - Parameter 2 is only required if the device is a full-duplex device. If the device is half-duplex, either this parameter must not be entered or must be entered the same as paremeter 1. If the device on which RING and LINE DISCONNECT are to be detected is a full-duplex device, "input" is the logical device name of the device connected to the input channel.

[options] - Parameter 3 is optional. It specifies line monitoring characteristics as follows:

Ring Support	RING	(#1000)
Auto Task Line Connect Support	CONN	(#0800)
Auto Task Line Disconnect Support	DISC	(#0400)
Line Disconnect Delay Support	DELAY	(#0200)

Auto Task Line Connect Support, Auto Task Line Disconnect Support, and Line Disconnect Delay Support require that Ring Support be optioned. The default option is no ring support.

[task] - Parameter 4 is optional. It specifies the task name that is to be notified (by a packet queued to it) when a BREAK, RING, or LINE DISCONNECT is detected from the supported device. All these task names must be only 3-characters long. The default task name is TMP (Terminal Monitor Program).

[prefix] - Parameter 5 is optional. It specifies a 3-character CAN-codable task name prefix to be used as the prefix to the initial attentive task name. The 3-character suffix to the task name will be the line number in decimal ASCII. A line number is based on the LINEMONITOR statement ordering. The line number of the first LINEMONITOR statement is "001". The line number of each additional statement is "002", "003", et cetera. If this parameter is not supplied then there will be no initial attentive task name.

[delay] - Parameter 6 is optional. It specifies the number of ticks to delay after detecting a line disconnection. The time delay operates at low clock level. This parameter is used in conjunction with Line Disconnect Delay Support (DELAY) only and the default delay is 3 seconds or 600 ticks.

PROGRAMMER'S ERROR BIT IN UFT WORD UFTSTA	OPERATOR'S REASON CODE	REASON FOR ERROR IF SET
0	ER	SOME ERROR EXISTS
1	OVF	UNDERRUN/OVERFLOW
2	PAR	CRC ERROR (INPUT)
3	INO	POWER OFF OR WATCHDOG TIMER EXPIRED
4	MPE	MEMORY PARITY ERROR/ ILLEGAL BUFFER
5	LOK	DEVICE UNDER EXCLUSIVE USE
6	CIG	TRANSMIT ABORT RECEIVED
7	OTH	INPUT = CD DROPPED OUTPUT = CTS DROPPED

Table 4-1. SDLC/HDLC Frame Handler Errors and Events

CHAPTER 5
MAX IV STANDARD LINK FRAME LEVEL HANDLER

The Standard Link Frame Level Handler is designed to run under control of a MAX IV Operating System in order that user tasks may communicate with one or more Model 4828 Standard Link Controllers. The 4828 Controller communicates with devices conforming to SDLC/HDLC protocol.

A frame (or message) under these protocols consists of the following fields:

Flag	(8 bits)
Address	(8*m bits, where m=1,2,3,... for HDLC) (8*m bits, where m = 1 for SDLC)
Control	(8 or 16 bits for HDLC) (8 bits for SDLC)
Information	(8*n bits, where n=0,1,2,...)
Check Sequence	(16 bits)
Flag	(8 bits)

The controller provides the initial Flag, the Check Sequence, and the final Flag. A task requesting the READ/WRITE services of the handler must provide the Address, Control, and (optional) Information fields.

A projected usage of this handler is as the "real device" with which a symbiont task communicates. Such a symbiont task could provide the Address and Control fields in a manner consistent with the appropriate protocol in use, thus freeing the user tasks from such concerns. Under such a system, user tasks would only be required to provide Information to be transferred. To allow such a symbiont task, the handler provides READ/WRITE services with a frame in either a single block (Address, Control, and optional Information) or a double block (block one containing Address and Control and block two containing Information) mode.

The handler provides a MODE command (HOME) to allow user control of modem signals and a DIAG command (HOME) to allow privileged tasks to perform operations required to support on-line diagnostics.

The handler accepts "standard" system support of TAKE exclusive use, GIVE up exclusive use, and TERMINATE requests. No positioning services are included (such requests simply return a status indicating EOF+BOM).

5.1 OPERATIONS AND MODES

The handler supports six REX services:

READ (input only)
WRITE (output only)
HOME (output only)
GIVE
TAKE
TERMINATE

The handler accepts the system standard handling of quick return or wait modes of operation. Although no retries are performed automatically by the handler, the handler accepts local or system recovery.

No Device Dependent Option (DDO) is supported. The handler processes byte strings without checking for any special characters. The handler makes no distinction between Standard ASCII, Non-Standard ASCII, Standard Binary, and Non-Standard Binary.

5.2 TIMERS

WRITE and READ requests support an extended option of a User Specified Timer (UST). If a user request specifies Bit 5 of the extended option word (XUFOPT) of the User File Table (UFT) to be a one, the contents of register 3 will be assumed to contain the number of ticks to allow before an operation is completed (a value of zero implies no time out). If the bit is a zero, a default value (200 for output and zero for input) will be used.

These timer values have effect only if the controller is declared TIMED at SYSGEN, since an UNTIMED controller will never time out.

5.3 BUFFERS

READ and WRITE requests utilize buffers of information in one of two modes:

- Single Block Mode
- Double Block Mode

5.3.1 SINGLE BLOCK MODE

Single Block Mode is selected by any non-negative buffer size. Single Block Mode buffers contain/receive the Address, Control, and optional Information. The byte count must be at least as large as the size of the combined Address and Control fields that was specified at SYSGEN. This combined size was specified in the extended characteristic word of the CONTROLLER Statement. If the byte count is not that large overflow or underrun errors will occur.

The buffer size will be limited by the logical device size (like other devices) unless the logical device is specified as unlimited. The transfer count that is returned to the UFT will indicate the actual number of bytes transferred to or from the link.

If the SYSGEN specified size of the combined Address and Control fields is odd, the buffer will be assumed to be odd byte aligned so that the first information field byte will be word aligned.

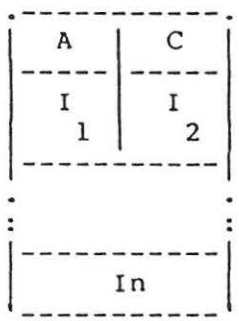
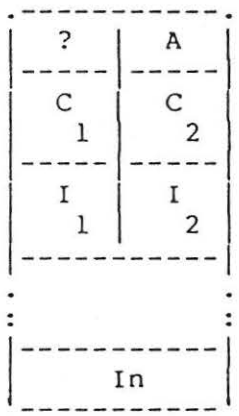
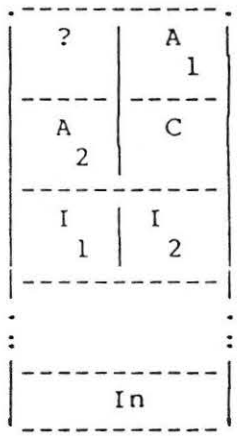
Address size	Control size	Buffer
1	1	
1	2	
2	1	

Figure 5-1. Single Block Mode

5.3.2 DOUBLE BLOCK MODE

Double Block Mode is selected by a negative buffer size. A four-word Descriptor is addressed using the "buffer" address provided by the user. The Descriptor is formatted in Figure 5-2.

The "Buffer" is actually a "Descriptor" if a negative size is given.

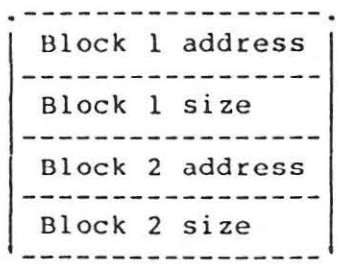


Figure 5-2. Double Block Mode Descriptor Format

The first block is used to contain/receive the Address and Control. The size specified must correspond with the size given at SYSGEN. If the size of block 1 is odd, it must be odd-byte aligned (so that the Information field is always even-byte aligned).

The count returned to the UFT will include only the number of bytes transferred to or from block 2. The size of block 2 is limited only by the DMP to be in the range (1 through 32768). If either block size is illegal the handler will simulate an overflow/underrun error (for compatibility with single block buffer size errors).

NOTE: In either mode the Information Field is word-aligned and may be either even or odd in length (the final byte need not be on a word boundary). The odd byte will be modified during a READ, but the count will reflect the fact that an odd length Information field was received and that the extra byte should be ignored.

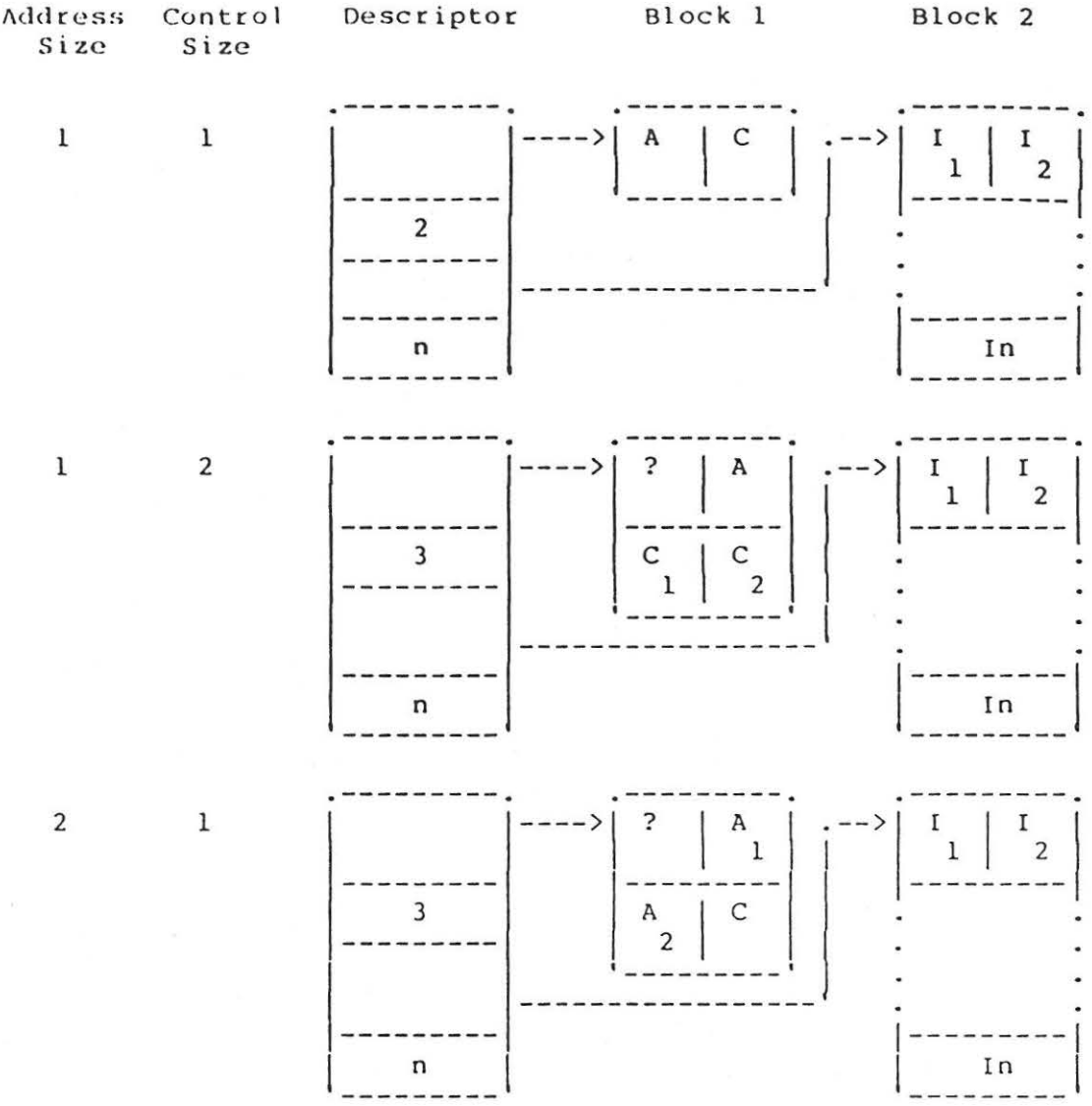
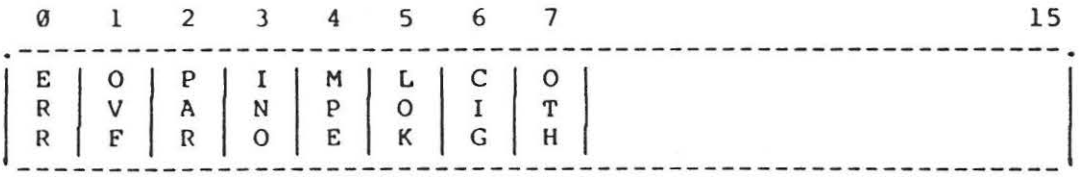


Figure 5-3. Double Block Mode

5.4 I/O SERVICES

5.4.1 READ (INPUT LINK DEVICE ONLY)

READ operations to an input link device cause the next message received by the link to be sent to the user's buffer (single or double block). The link determines whether a specific message is acceptable (primary or secondary link versus global or local message). The handler makes no attempt to modify the selection process the hardware uses. The transfer count word will show the number of valid bytes in the final (or only) block. Possible errors from a READ operation are detailed in the UFT status word (UFTSTA).



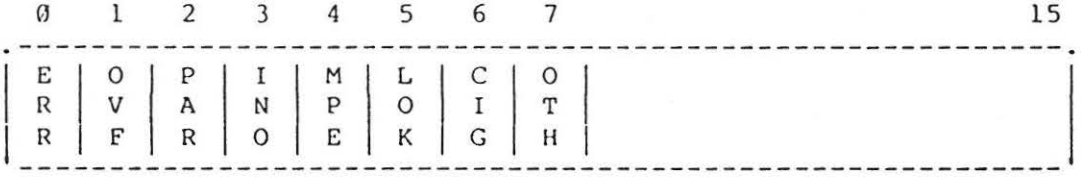
0 - ERR - At least one of bits 1 through 7 is set.
1 - OVF - Data overflow, buffer size violation, frame longer than buffer.
2 - PAR - Hardware detected Cyclic Redundancy Check (CRC) error.
3 - INO - Device timeout or lack of DSR after Malfunction (refer to LOK).
4 - MPE - Input/Output Processor (IOP) error.
5 - LOK - Malfunction (refer to INO or OTH for specific failure).
6 - CIG - Abort character detected.
7 - OTH - Lack of Carrier Detect (CDET) after Malfunction (refer to LOK).

Figure 5-4. UFT Status Word (UFTSTA) After READ

A Malfunction occurs when either DSR or CDET drop after the READ is started. It is possible that both will be set at the time the handler checks for the cause of the Malfunction since these status lines are dynamic. If transient failures occur, the status may show LOK without INO or OTH.

5.4.2 WRITE (OUTPUT LINK DEVICE ONLY)

WRITE operations to an output link device cause the user's buffer (single or double block) to be transferred to the link. The UFT transfer count word (UFTBCT) will show the number of bytes actually transferred from the final (or only) block to the link. Possible errors from a WRITE operation are detailed in the UFT status word (UFTSTA).



0 - ERR - At least one of bits 1 through 7 is set.
1 - OVF - Data underrun or buffer size violation.
2 - PAR - Not possible.
3 - INO - Device timeout or lack of Data Set Ready (DSR) after Malfunction (refer to LOK).
4 - MPE - IOP error.
5 - LOK - Malfunction (refer to INO or OTH for specific failure).
6 - CIG - Not possible.
7 - OTH - Lack of Clear to Send (CTS) after Malfunction (refer to LOK).

Figure 5-5. UFT Status Word (UFTSTA) After WRITE

A Malfunction occurs when DSR or CTS drop after a WRITE begins. It is possible that both will be set at the time the handler checks for the cause of the Malfunction since these status lines are dynamic. If transient failures occur, the status may show LOK without INO or OTH.

5.4.3 HOME (OUTPUT LINK DEVICE ONLY)

The HOME service is used to issue MODE requests or DIAG requests (privileged tasks only). The MODE or DIAG request is selected with bits in the Device Dependent Option field (Bits 8-15) of the Extended UFT Option Word (XUFOPT). Both lines may be reset with a single MODE command. If both DIAG requests are set, the Programmed ICB will be issued prior to the Internal Wraparound command. MODE and DIAG commands cannot be made with a single request (DIAG requires Bits 8 and 9 both be zero).

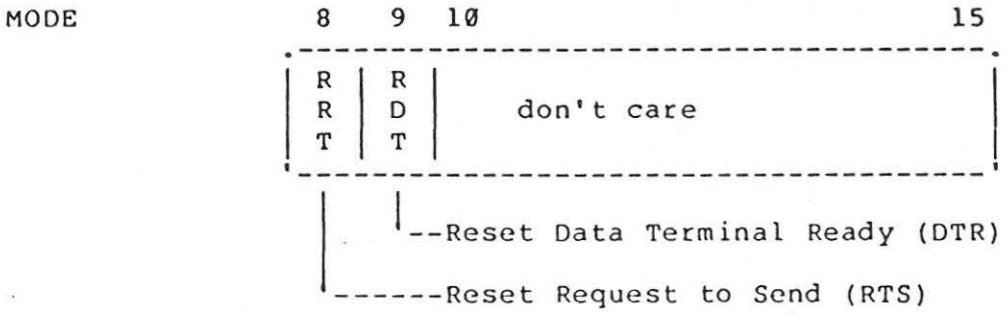


Figure 5-6. Extended UFT Option Word (XUFOPT) for MODE Request

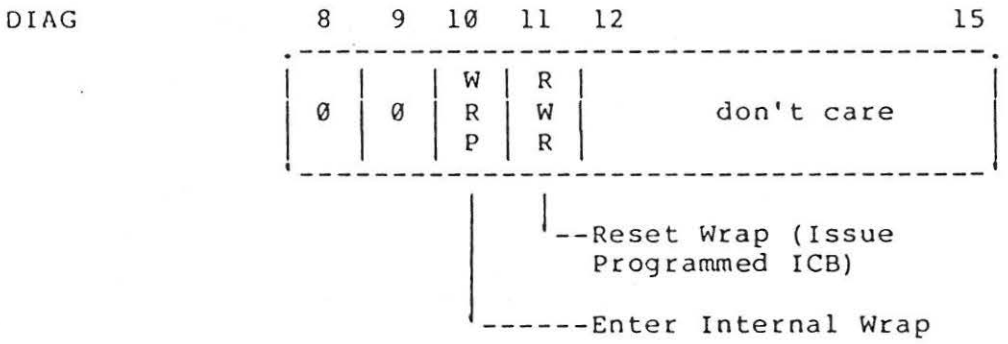


Figure 5-7. Extended UFT Option Word (XUFOPT) for DIAG Request

5.4.4 REWIND

With MAX IV Revision H.0, the REX REWIND service is a null operation.

5.4.5 TERMINATE, TAKE, GIVE

The following requests to the handler are supported in the standard system manner:

- o TERMINATE
- o TAKE Exclusive Use
- o GIVE UP Exclusive Use

5.5 SYSTEM GENERATION

Since the Model 4828 Controller consists of two communication channels, the handler actually appears to be two handlers from the point of view of the system manager (the person responsible for performing SYSGENs). A pair of CONTROLLER statements must be included for each Model 4828 Controller: one with controller name OLx and another with controller name ILx. The other statements used to support the 4828 Controller present no new concepts to the system manager since FMTRANSPORT and DEVICE are used in a "standard" fashion. DEVICE is the only required statement.

5.5.1 CONTROLLER STATEMENT

DEFINE EACH HALF OF THE 4828 CONTROLLER

SYNTAX

```
                    1   2   3     4        5 6 7 8 9 10
CONTROLLER      nam,#gu,dmp,[TIMED  ],, , , , , ,xcw
                           [UNTIMED]
```

nam - Parameter 1 is the controller name and must be OLx for the output half and ILx for the input half.

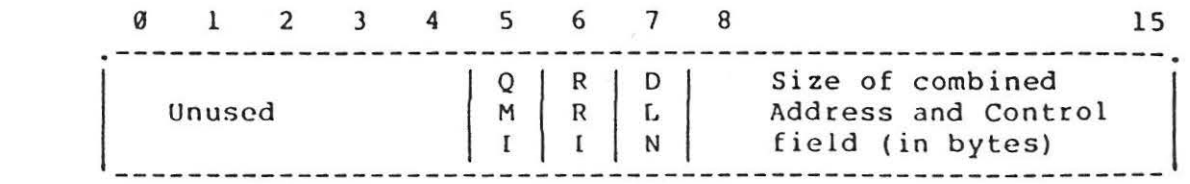
#gu - Parameter 2 is the group and unit number and must be even for the output half and odd for the input half.

dmp - Parameter 3 specifies the DMP channel number and must be even for the output half and odd for the input half.

[TIMED]
[UNTIMED] - Parameter 4 specifies whether READ/WRITE operations will be timed or not.

- Parameters 5 through 9 are not used for the 4828 Controller and should be defaulted.

xcw - Parameter 10 specifies the extended characteristics word for the controller. This word is formatted as follows:



QMI (Quick Mode Initiate) set equal to 1 implies that quick mode initiates (ignore modem malfunctions) should be used for the controller.

RRI (Reset Request to Send Inhibit) set equal to 1 implies that modem signal RTS need not be reset at the completion of WRITE requests (at a PRIMARY station or a SECONDARY station on a full-duplex point-to-point link).

DLN (Directly Linked) set equal to 1 implies that the controller is directly linked to a device and that no modem support is required.

Bits 8 - 15 should be set equal to the combined size in bytes of the Address and Control Fields.

5.5.2 DEVICE STATEMENT

DEFINE LOGICAL DEVICE(S) FOR EACH HALF OF A CONTROLLER

SYNTAX

```
                    1    2    3
DEVICE          dnam,cnam[,bpr]
```

dnam - Parameter 1 specifies the logical device name to which user tasks assign logical files in order to communicate with the Handler.

cnam - Parameter 2 specifies the name used in the appropriate CONTROLLER statement.

bpr - Parameter 3 specifies the record size limit (in bytes) for the device in single block transfers. If no size is specified, the default value of zero will allow unlimited record sizes in both Single Block Mode and Double Block Mode transfers.

CHAPTER 6
MAX IV COMPUTER LINK/DATA TERMINAL HANDLER

The Computer Link Handler (CL.HAN), serves as the interface between the user task and the 4805 general purpose data terminal and/or the 4820 computer link. The handler is used to interface a MODCOMP computer to a variety of custom interfaces as well as providing a computer-to-computer link.

This handler is designed to run on the MAX IV Operating System under DMP control and on a CLASSIC, utilizing a 4805 or 4820 controller.

6.1 REX I/O SERVICES

The Computer Link/Data Terminal Handler supports five REX functions:

READ
WRITE
TERMINATE
TAKE
GIVE

The standard MAX IV I/O call and return conventions apply.

All I/O calls require that the program supply a register argument in R2 before the service is called. This register must contain an address that points to the User File Table (UFT) that contains localized arguments associated with the I/O operation.

The MODCOMP Data Formats (Standard ASCII, Non-Standard ASCII, Standard Binary, and Non-Standard Binary) are not supported as such. The handler processes byte strings without checking for any special characters.

6.1.1 REX READ, WRITE

The Data Transfer services READ and WRITE require two arguments. One argument specifies the address of the data buffer and the other buffer size in bytes. These arguments may exist as an extension of the UFT or the user can use register 14 (R14) and register 15 (R15) to pass the buffer address and size. If R14 and R15 are to be used the UFT option BBR must be set in the extended option word.

6.1.2 TERMINATE

The TERMINATE service is similar in calling sequence to the data transfer services, except the buffer address and byte count are not necessary. Also, the terminate service is not a queued operation. It immediately dequeues (and terminates if necessary) all I/O operations that are in the queue for the file's assigned device and that were queued by the calling task. If the Quick Return option bit is set, all device operations are dequeued even if not queued by the calling task. Tasks must be privileged to perform the latter function.

6.1.3 TAKE, GIVE

The TAKE and GIVE exclusive use services allow a task to exert exclusive control over a device. Requests for exclusive use may be requested as an immediate operation or as a queued request. This is useful if quick-return mode is used in I/O operations, and a group of records must be written contiguously.

6.1.4 OTHER REX OPERATIONS

The REWIND, BACKSPACE FILE, BACKSPACE RECORD, ADVANCE RECORD, ADVANCE FILE, WRITE END-OF-FILE, and HOME operations are not implemented and perform as null operations if requested.

6.2 SYSTEM GENERATION

The following statements are required in a system generation source file if the Model 4820 MODCOMP-MODCOMP Computer Link is to be included in the system.

```
CONTROLLER      CL,G/U#,DMP#

DEVICE          CL,CL
```

The following statements are required in a system generation statement deck if the Model 4805, General Purpose Data Terminal controller is to be included in the system.

```
CONTROLLER      DT,G/U#,DMP#

DEVICE          DT,DT
```

Detailed descriptions of these statements and the rules of order in which they must be entered are included in the MAX IV SYSTEM, System Guide Manual.

PROGRAMMER'S ERROR BIT IN UFTSTA	OPERATOR'S REASON CODE	REASON FOR ERRORS IF SET
Ø	ER	-ERROR, SEE OTHER BITS -CONTROLLER NOT PRESENT
1	OVF	-NOT USED
2	PAR	-NOT USED
3	INO	EXTERNAL DEVICE ERROR
4	MPE	DMP MEMORY PARITY ERROR
5	LOK	EXTERNAL DEVICE ERROR
6	CIG	-NOT USED
7	OTH	CONTROLLER BUSY
8	HOL	-NOT USED

Table 6-1. Computer Link/Data Terminal Errors and Events

CHAPTER 7
MAX IV ASYNCHRONOUS FLOPPY DISC HANDLER

The 4523 Asynchronous Floppy Disc (AFD) is a microprocessor controlled stand-alone floppy disc storage device. It is connected as a peripheral to the host computer with a 1907-type half-duplex asynchronous communications channel. The MAX IV Asynchronous Floppy Disc Handler is the software interface between MAX IV's Basic I/O System (BIOS) and the 4523 hardware. The AFD may be controlled by the following 1907 class communication controllers:

Model 4804	QCIC	Quad Channel Interface Controller
Model 4808	AMC	Asynchronous Modem Controller
Model 1907	UCS	Universal Communication Subsystem
Model 4806/4807	ATC	Asynchronous Terminal Controller
Model 1908	ICS	Integrated Communication Subsystem
Model 4809	OAI	Octal Asynchronous Interface

The primary purpose of the handler is to process bidirectional ASCII or binary data transfers in either DI or DMI mode between the user tasks and the AFD device diskette. All commands and status are transferred with a frame size of eight bits with switch selectable parity. Modem control/status lines are used to synchronize command and data exchanges.

The Asynchronous Floppy Diskette has 77 tracks, one head per cylinder, and 128 words for each sector. Two models of AFDs are available. One with 15 sectors per track (single density diskette) and another with 26 sectors per track (double density diskette). The permissible geometries for a single density diskette are 1, 3, 5, 9, 11, 13, and those for a double density diskette are given by g satisfying $1 \leq g \leq 24$ and $g \neq 5, 10, 15$ or 20.

The handler supports 12 Request Executive (REX) services:

READ
WRITE
REWIND
HOME
WEOF
BACKSPACE RECORD
BACKSPACE FILE
ADVANCE RECORD
ADVANCE FILE
TAKE
GIVE
TERMINATE

All supported REX services allow Quick Return (that is, allow invoking task to execute as soon as the operation is queued) and Wait Return (that is, delay invoking task until the operation has been performed) modes of operation.

No distinction is made between Standard ASCII, Non-Standard ASCII, Standard Binary, and Non-Standard Binary data transfers.

7.1 ACCESS METHODS

7.1.1 FILE POSITION INDEX

The sector (starting sector for unlimited record size partitions) that is accessed during an operation is determined by the RAN flag in the UFT option word. If this bit is reset, a Sequential access mode is assumed and the current File Position Index (FPI) that is maintained in the File Assign Table (FAT) Entry is used as the relative sector number. This number is converted by the handler to a hardware sector number that is appropriate for the partition's defined geometry. When the operation is successfully completed, the FPI value is incremented so that the next operation to this file will be to the next relative sector. This incremented value is then moved to the calling task's User File Table (UFT). If the RAN flag is set, a Random access mode is assumed and the FPI in the calling task's UFT is used directly as the desired relative sector number. Again, this is converted to the actual hardware sector by the handler's geometry algorithm. When the operation is successfully completed, the FPI in the UFT is incremented.

It can easily be seen that, if the calling task never modifies the FPI in its UFT, after initially set, sequential operation occurs thereafter by default. This is true even in the Random access mode until the task modifies the FPI in the UFT. It should also be obvious that, since addressing of a partition is maintained at the UFT or file level, the task may keep many unique sequential pointers within the same disc partition by assigning the partition to a different file name for each independent index desired.

For partitions with unlimited record size, the sequential index system is useless, particularly in a Sequential mode, because it always points to the next relative sector. When such partitions are being used with records larger than a sector, the "next" sequential record may be accessed by the task manually incrementing the UFT's FPI by an amount equal to the number of hardware sectors contained in each record. Only the Random access mode and a geometry of 1 are convenient for such usages.

7.1.2 DEVICE POSITION INDEX

For privileged programs, Device Position Index (DPI) or a physical diskette address (STC) may be specified. A DPI is used much the same way as a FPI, except that it is specified as position (relative to the beginning of the physical/logical transport) instead of relative to the beginning of a disc partition.

A DPI may be specified as either a single word or double word index based on the value of the UPP flag in the Extended UFT option word (XUFOPT). A physical Sector/Track/Cylinder (STC) diskette address must be specified in a double word pointed to by UFT word UFTDPI (thus the UPP flag in XUFOPT must be set) and has the following format:

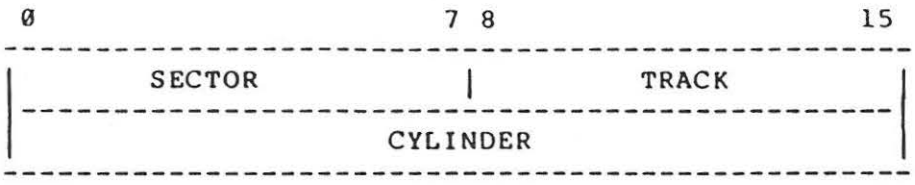


Figure 7-1. Sector/Track/Cylinder Address

All of these privileged addressing modes require the user to specify the mode type (LT DPI, ABS DPI, or STC) in UFT word XUFOPT and to set the RAN flag in UFT option word (UFTOPT). The user's logical file must be directed to a logical device (disc partition) associated with the diskette being addressed. The partition's geometry and logical device size are ignored.

7.2 REQUEST EXECUTIVE (REX) SERVICES

7.2.1 READ

The READ operation causes one logical record to be read into the calling task's buffer from a logical device on a diskette. Logical record sizes are defined by specifying a bytes-per-sector value for each logical device associated with a physical diskette. Logical devices are defined using the DISCDEVICE statement either at System Generation (SYSGEN) time or when specifying transient partitions.

A start-of-buffer address and transfer count (bytes) must be supplied as in READ requests to other handlers. At the completion of a READ, the "standard" changes to the user task's UFT will be made. The byte count will show the number of bytes actually transferred and the status will signal any errors of concern to the user.

"Scatter Read" (that is, data chained input) is not supported and any attempt to utilize this method of transferring data is considered an error condition. Non-privileged tasks attempting scattered reads receive an error reason code of 'PRV CHN', whereas privileged tasks receive an error reason code of 'AFD CHN'.

7.2.1.1 Limited Record Size Disc Partition Transfers

If the transfer count requested is equal to or smaller than the logical record size, the transfer is terminated at the specified byte (optionally odd) count. Transfers requested that would exceed the logical record size are adjusted such that they equal the logical record size and are then performed for the calling task. Byte count specifications of 0 do not result in any data being passed from the addressed diskette to the calling task's buffer and a UFT status of 0 is returned.

7.2.1.2 Unlimited Record Size Disc Partition Transfers

If a partition has been specified as having an unlimited record size, a buffer size of up to 32,768 bytes (4,096 bytes if the Direct Memory Interface (DMI) is being utilized) can be specified with one READ operation. Attempting to read more than 4096 bytes when utilizing the Direct Memory Interface is considered an error condition and has an associated error reason code of 'AFD DMI'.

Byte count specifications of 0 do not result in any data being passed from the addressed diskette to the calling task's buffer and a UFT status of 0 is returned. If a sector is encountered in the range of the READ that has an End-of-Record (EOR) mark set, the transfer and disc read operation terminate automatically at the end of this marked sector and the Beginning-of-Media (BOM) event bit is set.

7.2.1.3 End-of-File (EOF)/End-of-Media (EOM) Indicators

If a sector was originally written with a WRITE END-OF-FILE (WEOF) operation, the EOF event bit in the calling task's UFT is set when the sector is read. The calling task's buffer also has the ASCII value '$$' stored in bytes 0 and 1 if the byte count specified in the original READ operation is greater than 1.

If the last sector of a partition is read, the EOM event bit is set. Any attempts to exceed this sector address with a forward operation (READ or ADVANCE FILE/RECORD) is considered an error condition and has an associated error reason code of 'FPI XXX' where 'XXX' equals the logical file name being referenced.

7.2.2 WRITE

A WRITE operation causes one logical record to be written to a logical device from the calling task's buffer. Logical record sizes are defined by specifying a byte-per-sector value for each logical device associated with a physical diskette. Logical devices are defined using the DISCDEVICE statement either at SYSGEN time or when specifying transient partitions.

A start-of-buffer address and transfer count (bytes) must be supplied as in WRITE requests to other handlers. At the completion of a WRITE, the task's UFT will be updated in the "standard" manner. The byte count will show the number of bytes actually transmitted and the UFT status will show any errors that occurred.

"Gather Write" (that is, data chained output) is not supported and any attempt to utilize this method of transferring data is considered an error condition. Non-privileged tasks attempting gathered writes receive an error reason code of 'PRV CHN'. Privileged tasks receive an error reason code of 'AFD CHN'.

7.2.2.1 Limited Record Size Disc Partition Transfers

If the transfer count requested is equal to or smaller than the logical record size, the transfer is terminated at the specified byte (optionally odd) count. Transfers requested that would exceed the logical record size are adjusted such that they equal the logical record size and are then performed for the calling task. Byte counts of Ø do not result in any data being passed to the addressed diskette from the calling task's buffer and a UFT status of Ø is returned.

7.2.2.2 Unlimited Record Size Disc Partition Transfers

If a partition has been specified as having an unlimited record size, a buffer size of up to 32,768 bytes (4,Ø96 bytes if the Direct Memory Interface is being utilized) can be specified with one WRITE operation. Attempting to write more than 4Ø96 bytes when utilizing the Direct Memory Interface is considered an error condition and has an associated error reason code of 'AFD DMI'.

Byte count specifications of Ø do not result in any data being passed to the addressed diskette from the calling task's buffer and a UFT status of Ø is returned. An End-of-Record mark flag will be written in the last sector that falls within the write range if this feature has been optioned for the partition (refer to DISCDEVICE statement) or if bit 7 (write record mark) of the Extended UFT Option word XUFOPT is asserted. This flag causes a multisector READ operation to terminate short of its specified buffer size if this sector is encountered before the specified block size is satisfied.

7.2.2.4 End-of-Media (EOM) Indication

If the last sector of a partition is written, the EOM event bit is set. Any attempt to exceed this sector address with a forward operation (WRITE or WEOF) is considered an error condition and has an associated error reason code of 'FPI XXX' where 'XXX' equals the logical file name being referenced.

7.2.3 REWIND

The handler supports "REWIND I/O disc partition." The REWIND operation does not cause any data to be transmitted to or from the diskette being addressed. For the operation to successfully complete, the logical device or disc partition must not be off-line. The File Position Index (FPI) is reset to Ø in the calling task's UFT and in the file assign list entry. The EOF and BOM event bits are set in the UFT status word.

7.2.4 HOME

The handler supports "normalize I/O disc partition." The HOME operation does not cause any data to be transmitted to or from the diskette being addressed. For the operation to successfully complete, the logical device or disc partition must not be off-line. The EOF and BOM event bits are set in the UFT status word.

7.2.5 WRITE-END-OF-FILE

The handler supports "WRITE END-OF-FILE mark on I/O disc partition." The WRITE END-OF-FILE (WEOF) operation causes the addressed sector, as specified by the current FPI, to be written with a two-byte buffer containing the bytes '$$'. The remainder of the sector is zero filled by the hardware. The FPI is incremented by 1 and the EOF event bit is set in the UFT status word. End-of-Media (EOM) handling is processed in the same fashion as in the case of the WRITE REX service request.

7.2.6 BACKSPACE RECORD

The handler supports "BACKSPACE RECORD on I/O disc partition." The BACKSPACE RECORD (BKRECORD) operation subtracts 1 from the FPI and then reads the indicated software sector. When the READ operation is complete, the FPI is set to the sector just read so that this is the next sector accessed on the next forward operation. If the accessed sector was a file-mark record ($$), the EOF bit is set in the calling task's UFT. If backspacing beyond sector 0 of a logical device is attempted, no operation occurs and the EOF and BOM event bits are set in the UFT status word.

7.2.7 BACKSPACE FILE

The handler supports "BACKSPACE FILE on I/O disc partition." The BACKSPACE FILE (BKFILE) operation is similar to BKRECORD except that the process continues until a file-mark record or BOM indication is detected. The appropriate event bits are set in the calling task's UFT. The operation node is dequeued at the end of each disc record and then requeued so that higher priority operations on the disc controller can take precedence over its completion.

7.2.8 ADVANCE RECORD

The handler supports "ADVANCE RECORD on I/O disc partition." The ADVANCE RECORD (AVRECORD) operation is similar to BKRECORD except that the FPI is incremented in a forward direction. The EOF event bit in the calling task's UFT is set if a file-mark record is encountered. If the last sector of the partition is encountered, the EOM event bit is also set. If the program addresses beyond this last sector, this task's request is considered to be an error and a reason code of 'FPI XXX' is issued where 'XXX' equals the logical file name being referenced.

7.2.9 ADVANCE FILE

The handler supports "ADVANCE FILE on I/O disc partition." The ADVANCE FILE (AVFILE) operation is similar to BKRECORD except that the FPI is incremented in a forward direction. This operation continues until a file-mark record or EOM (last sector of partition) is detected. The appropriate bits are set in the calling task's UFT. The operation node is dequeued at the end of each disc record and then requeued so that higher priority operations on the disc controller can take precedence over its completion. If the task addresses beyond the last sector of a partition, this task's request is considered to be an error and a reason code of 'FPI XXX' is issued where 'XXX' equals the logical file name being referenced.

7.2.10 TAKE, GIVE, TERMINATE

The handler supports the following according to "standard" MAX IV procedures:

- "TAKE Exclusive Use of I/O disc partition"
- "GIVE Exclusive Use of I/O disc partition"
- "TERMINATE I/O disc partition"

7.3 DEVICE DEPENDENT FEATURES

There are several features available as options to the user. These options can be requested by selecting the appropriate bit(s) in the Extended UFT Option Word (XUFOPT). Figure 7-2 shows the Extended UFT Option Word, XUFOPT.

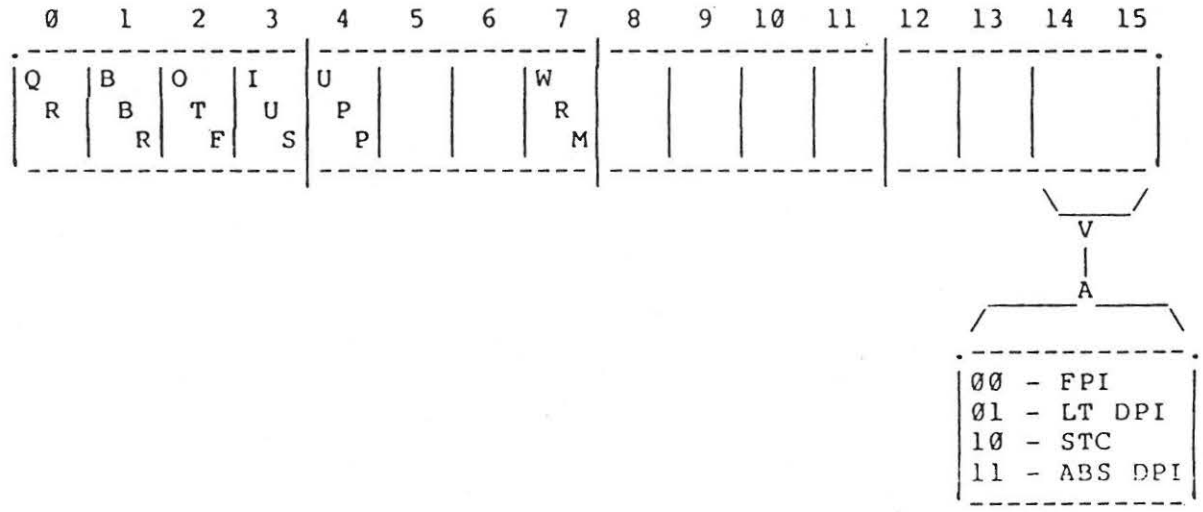


Figure 7-2. Extended UFT Option Word (XUFOPT)

The first five options (bits 0 through 4) are available throughout the MAX IV I/O system. They are described in the MAX IV BASIC I/O SYSTEM, System Guide Manual.

7.3.1 WRITE RECORD MARK - BIT 7 - WRM

A WRITE operation to a partition does not cause an End-of-Record (EOR) mark to be added to the last sector of the record unless either the DISCDEVICE SYSGEN statement specifies its unconditional addition or this bit is set in XUFOPT. Once an EOR mark has been written, a READ operation on that record cannot progress beyond the sector containing the EOR. These marks are generally used only when a partition has an unlimited record size and the calling task wishes to use the EOR detection capability to delimit records. To indicate detection of an EOR on a READ, the BOM bit in the UFT status word is set.

7.3.2 ADDRESSING MODES - BITS 14-15

For privileged tasks, addressing modes other than the usual File Position Index (FPI) mode are available. These alternate addressing modes include:

- Logical Transport Device Position Index - LT DPI
- Sector/Track/Cylinder - STC
- Absolute Transport Device Position Index - ABS DPI

Figure 7-2 shows how these addressing modes are encoded.

Logical Transport Device Position Index (LT DPI) is a mode similar to the FPI except that it specifies a position relative to the start of the logical transport rather than relative to the start of a disc partition.

Sector/Track/Cylinder (STC) mode is similar to DPI except that it requires the use of a double word index and specifies the absolute sector and track in each half of the first word and the absolute cylinder in the second word. Refer to Figure 7-1.

Absolute Transport Device Position Index (ABS DPI) specifies an absolute position relative to the start of the physical disc.

NOTE: The concepts of geometry and partition size are not meaningful for these alternate addressing modes.

7.3.3 PREP CAPABILITY

Prep mode WRITE operations are not supported with this device. The user may optionally prep a diskette located in unit 0 by depressing the "FORMAT" switch on the front panel of the device, causing sector header information to be written on the diskette.

7.3.4 COPY CAPABILITY

In a dual drive system, operating the "COPY" switch causes the contents of the diskette inserted in drive 1 to be copied onto the diskette in drive 0.

7.4 ERROR HANDLING

Numerous error conditions can occur, which the handler must be prepared to resolve in a reasonable fashion. Those error conditions are described here and it is the intent of this section to relate to "recovery" and "retry" mechanisms that will be utilized.

7.4.1 SYSTEM ERROR RECOVERY PROCEDURES

The handler will automatically retry operations that were initially unsuccessful in completing. Eight retries will be attemped if an error condition occurs.

A floppy device related error is categorized as any one of the following types:

- o DATA RATE OVERFLOW

  This error indicates the AFD was unable to read the input channel before another character was received.

- o CHECKSUM ERROR

  This error indicates a CRC or parity error was detected by the AFD on a READ operation.

- o SEEK ERROR

  This error indicates device's selected drive is not positioned on the correct cylinder.

A communications related error is categorized as any one of the following types:

- o MALFUNCTION

  This error indicates the modem signals/lines DSR, CTS, and CD underwent state changes inconsistent with normal operation, after a transfer had been initiatiated. This error also indicates a possible synchronization conflict in reference to the current operation to the AFD device. The protocol used allows for the AFD device to abort an operation early due to errors (for example CRC) it detects during transmission. This causes the handler to report a communication malfunction along with the associated device error.

- o PARITY ERROR

  This error indicates that either the AFD or the handler detected a parity error on its associated input channel.

- FRAMING ERROR

  This error indicates that either the AFD or the handler detected a framing error on its associated input channel.

- DATA RATE OVERFLOW

  This error indicates the handler did not read the input data buffer in the controller prior to receipt of the next character from the line.

- MEMORY PARITY ERROR

  This error indicates that a memory parity error occurred during a direct memory transfer or that a chaining violation was detected by the communications processor.

- COMMAND ERROR

  This error indicates that the last received command was illegal and rejected by the AFD.

- DATA TRANSFER COUNT OVERRUN

  This error indicates that during a WRITE operation, the handler transmitted more data than specified in the original transfer count.

7.4.1.1 Offline Error

If the operation is still not successful after the retries, the handler "gives up" and puts the disc partition offline, thus causing the system to inform the operator of the unrecoverable condition. The format of the operator's message is as follows:

```
XXX OFFLINE YYY - ZZZZ
```

where,

'XXX' represents the disc partition name
'YYY' represents the offline error reason code
'ZZZZ' represents a copy of the UFT word UFTSTA.

Refer to Table 7-1 for Asynchronous Floppy Disc Communications Errors and Events.

Receiving an offline error reason code of 'OFF' means that no communications gear errors occurred, however, a disc error did occur and UFT word UFTBCT should be examined for the appropriate reason code.

```
XXX OFFLINE OFF-ZZZZ
```

Refer to Table 7-2 for Asynchronous Floppy Disc Device Errors and Events.

Receiving a UFT status indicating communication errors does not preclude an AFD device error from having occurred also. Most Malfunction Communication errors are the result of device errors (CRC, SEEK, et cetera) having occurred during transmission of a block of data. The disc partition stays offline with all subsequent operations being diverted to the partitions "slough" queue until the operator makes a decision. This decision may be:

- To try again.
- To let the program proceed as if the operation were successful.
- To abort the task using that partition.

If one of the following errors occurs, the handler does not attempt any retries, but immediately informs the operator:

- DEVICE INOPERABLE

  For example, power off.

- DIAGNOSTIC ERROR

  One or more of the device's components failed hardware self-diagnostic tests.

- WATCHDOG TIMER EXPIRATION

  An operation taking much longer than expected to complete.

7.4.1.2 LOK Abort

If a WRITE operation (includes Write End-of-File mark) is attempted to a sector that is in the range of the enabled write-protect system, it is treated as a programming error rather than a device error and the calling task is aborted with a reason code 'LOK'.

7.4.2 LOCAL ERROR RECOVERY PROCEDURES

If the program did not request system error recovery procedures (Bit Ø of the UFT option word reset), no error recovery is attempted but the calling task is immediately informed of the error condition by appropriate error bits being set in its UFT. The task must institute retry or device substitution operations itself in a manner appropriate to its application.

Requesting both local error recovery and setting RNQ (Return if Not Queued) in the UFT option word UFTOPT will inform the handler of the calling task's desire for retries if the operation was unsuccessful. In this case, however, the device will not be placed off-line if the operation still is not successful and control will be passed back to the calling task.

7.4.3 EVENT LOGGING MECHANISM

The handler will retry user requests that have failed if the user has instructed the handler to do so. A maximum of eight retries are attempted. If an operation retry is successful, the handler will log the following information:

Retry Number
Task Name
REX Service Number
Transport Name
Sector Number
Track Number
Cylinder Number
Primary Status
Device Dependent Status

The Retry Number is the positive number of the retry that was successful. The Primary and Device Dependent Status information relates to the failure status received on the operation directly before the retry that was successful.

Primary Status represents the status of the input and output communication channels and has the following format:

B0 - Input Channel Error if reset
B1 - Input Channel Frame Error
B2 - Input Channel Parity Error
B3 - Input Channel Memory Parity Error
B4 - Input Channel Overflow Error
B5 - Input Channel Malfunction Error
B6 - Input Channel Carrier Detect State
B7 - Input Channel Data Set Ready State
B8 - Output Channel Error if reset
B9 - Not Used
B10 - Not Used
B11 - Output Channel Memory Parity Error
B12 - Not Used
B13 - Output Channel Malfunction Error
B14 - Output Channel Clear To Send State
B15 - Output Channel Data Set Ready State

Device Dependent Status represents a slight modification of the Asynchronous Floppy Disc combined status word:

B0 - Error if reset
B1 - Overflow Error
B2 - CRC Error
B3 - Inoperable Drive
B4 - Command Error
B5 - Write Protected Diskette
B6 - Seek Error
B7 - Busy
B8 - Maintenance Mode

B9 - Not Used
B10 - Not Used
B11 - Not Used
B12 - Seek in Progress
B13 - Unable to Find Requested Sector
B14 - Channel Error
B15 - Unit Number

7.5 SYSTEM GENERATION

The following statements are examples of those required in a System Generation source file if an Asynchronous Floppy Disc is to be included in a system. Detailed descriptions of these statements and the rules by which they must be ordered are included in the MAX IV SYSGEN, System Guide Manual.

7.5.1 COMCONTROLLER

The COMCONTROLLER statement must be specified at least once for each communications line used in a MAX IV system. A unique name must be given to all controller names that includes all CONTROLLER, SYMCONTROLLER, and COMCONTROLLER statements. This statement generates the same data structure as that produced by the CONTROLLER statement with extensions. In addition, for each group of statements specifying the same group and unit number, a multiplexor table entry and appropriate driver code is produced. The statements specifying the same group and unit number must not be mixed with others specifying a different group and unit number. External references are also produced to ensure propriate device handler during the link-edit phase.

SYNTAX

```
                          1    2    3       4          5     6    7
COMCON[TROLLER] cname,#gu,chnl[,UNT[IMED]][,fdc][,fdn],cls
                                [,TIM[ED]  ]
                                [,VAC[ANT] ]

                          9        11       12
                      ,[,CL],[,parity][,baud]
```

cname - Parameter 1 is the communications controller channel name and must be unique for all controller names.

When this statement is used to configure the Asynchronous Floppy Disc, the first two characters must be AF and only the third character is used for uniqueness.

#gu - Parameter 2 is the "even" group and unit number concatenated into one hexadecimal quantity for this controller.

chnl - Parameter 3 is the 3-character controller channel number. For half-duplex, a COMCONTROLLER statement is required for each even numbered channel; for full-duplex, separate COMCONTROLLER statements are required for each output (even) and input (odd) channel.

[UNTIMED]
[TIMED]
[VACANT] - Parameter 4 is an optional keyword that determines whether this controller is timed. The default value for this parameter is UNTIMED. VACANT specifies that this channel is skipped. This parameter leaves a hole in the multiplexor table. If VACANT is specified, parameters 1, 2, 3, 4 and 7 are the only parameters accepted.

[fdc] - Parameter 5 is used only for full-duplex channels. It specifies the other channel number of the half-duplex channel to be used in conjunction with this one, to configure a full-duplex channel: the mate.

[fdn] - Parameter 6 is used only for full-duplex channels. It specifies the controller name, as specified in Parameter 1, of the "mate" (see description of Parameter 5 "fdc").

cls - Parameter 7 specifies the controller class. Enter one of the following keywords to define the class of the controller:

K = 4804, 4808, 4809, 4858, 1907, 1907A, 1907B, 1908 (DI) - AFD
L = 4806, 4807 - AFD
M = 1907, 1907A, 1907B, 1908 (DMI) - AFD

- Parameter 8 should be defaulted.

[CL] - Parameter 9 is an optional keyword used to specify that an asynchronous device has a current loop interface and is required for 1907/1907A type controller asynchronous channels. The default is not current loop.

- Parameter 10 should be defaulted.

[parity] - Parameter 11 is a keyword specifying the parity selection and may have the following values:

EVEN	Even parity
ODD	Odd parity
NONE	No parity (default)

[baud] - Parameter 12 specifies the line speed and may be specified as one of the following baud rates:

1200, 1800, 2000, 2400, 3600, 4800, 7200, 9600, 19.2 (indicating 19.2K baud), or the keyword EXTD for Extended/External (where the timing is supplied externally). The default value is 1200.

7.5.2 FMTRANSPORT

The FMTRANSPORT statement is required and must be specified for each transport. A physical transport, in general, is equivalent to a physical device to which one or more logical transports can be associated.

When the DISCCHARACTERISTICS statement is used, it must be given prior to the FMTRANSPORT statement for the same disc transport.

SYNTAX

```
                      1    2    3      4  5  6  7  8  9 10
   FMTRAN[SPORT] tname,tnum,cname[,  ,  ,  ,  ,  ,  ,xcw]
```

tname - Parameter 1 is the physical transport name (1- to 3-characters CAN-code). The name must be unique for all transports but there are no naming conventions (as there are for controllers).

tnum - Parameter 2 is the hardware transport number (0/1/2/3 for multi-transpor t controllers, 0 for single transport controllers) assigned to the transport as it is physically connected to the controller.

cname - Parameter 3 is the name of the controller to which this transport is connected (Refer to COMCONTROLLER statement).

- Parameters 4, 5, 6, and 7 are not used and should be defaulted.

- Parameters 8 and 9 are not used for the AFD and should be defaulted.

[xcw] - Parameter 10 (optional) specifies the type of AFD disc drive that is being SYSGENed with this particular statement. The type can be 1 (default) or 2 where:

1 = single density (15 sec/track)
2 = double density (26 sec/track)

7.5.3 LOGTRANSPORT

The LOGTRAN statement is used to define a logical transport on a physical transport. A structure known as a Logical Transport Table (LTT) is constructed for each LOGTRAN statement, therefore, more than one logical transport could be defined on a physical transport. A logical transport must be defined or contained on a single physical transport. There must be at least one LOGTRAN statement for every FMTRANSPORT statement. Partitions that are defined on a logical transport should reference the logical transport name and not the physical transport name.

SYNTAX

```
                          1    2     3    4   5      8
LOGTRA[NSPORT]    lname,pname,strk,ltrk,NOF,,[,EXC]
                                                [,NOE]
```

lname - Parameter 1 is the CAN-code name of the logical transport. This must be a unique name within the system.

pname - Parameter 2 is the name of a physical transport defined by a FMTRANSPORT SYSGEN statement.

strk - Parameter 3 is the actual starting track address for this logical transport.

ltrk - Parameter 4 is the size in number of contiguous track of the logical transport being defined.

NOF - Parameter 5 must be specified as the keyword NOF. A non-File Manager format LTT is generated.

- Parameters 6 and 7 are not used for the AFD and should be defaulted.

[EXC]
[NOE] - Parameter 8 is optional. It specifies the ability to take exclusive use of the entire logical transport. If the keyword EXC is given, taking exclusive use of the logical transport will be allowed. If the keyword NOE is given, taking exclusive use of the logical transport will not be permitted. The default is EXC.

NOTES:

- The LOGTRANSPORT statement(s) must immediately follow the FMTRANSPORT of the disc to which they apply.
- LOGTRANSPORT statements must be listed in the SYSGEN in the same order as their respective logical transports are defined on the physical disc.

- Overlapping of logical transports is not permitted and will result in an error message.
- The existence of areas of a physical disc not contained in some logical transport results in an error.
- Logical transports must be defined contiguously and must cover the entire physical transport.
- Logical transports are intended to be used on mixed-media drives (fixed and removable media).

7.5.4 DISCDEVICE

The DISCDEVICE statement is optional and, if present, specifies the name and size of a fixed, single-extent partition (contiguous number of tracks) on the referenced logical disc transport. These partitions are known as "logical devices" and are independent of the actual pack (volume) that is mounted on the transport. Once defined, the logical device may be associated with a logical file name and manipulated by a task that has made such an assignment. The entire logical transport cannot be manipulated in this fashion since it may not be assigned a logical device name but an equivalent capability can be arrived at by the subterfuge of defining a partition that includes all the tracks of the volume.

SYNTAX

```
                    1     2     3     4     5     6
DISCDE[VICE]  dname,tname,ntk[,geom][,bps][,atk]

                      7      8
                  [,xutsk][,WOR]
                  [,-infl][,NOW]
```

dname - Parameter 1 is the logical device name (1- to 3-characters CAN-code). The name must be unique for all devices (refer to DEVICE/COMDEVICE statements) in the system.

tname - Parameter 2 is the logical transport name on which this logical device is being defined and must already have been defined by a LOGTRANSPORT statement.

ntk - Parameter 3 is the size in number of contiguous tracks of the partition being defined. If Parameter 6 is missing, the starting track of the partition will be the track immediately following the last track address of the partition defined by the last DISCDEVICE for this logical transport. The starting track for the first DISCDEVICE statement for a particular transport will be the value passed from the LOGTRANSPORT statement.

[geom] - Parameter 4 is optional. It specifies the addressing geometry for the logical device. It describes a mapping of the logical sector address (implicit in the File Position Index in the User File Table associated with the REX service) into a physical sector address. A value of 1 for this parameter implies a 1:1 mapping which means that the logical sector address and the physical sector address are equivalent. This is the value that must be used for partitions that hold Quick-Load modules. The default is 4. The permissible geometries for a single density diskette are 1, 3, 5, 9, 11, 13, and those for a double density diskette are given by g satisfying $1 \leq g \leq 24$ and $g \neq 5, 10, 15, \text{or } 20$.

[bps] - Parameter 5 is optional. It specifies the bytes/sector value. If the given value is zero (0), then an "unlimited" blocksize is implied. The default for this parameter is defined by the DISCCHARACTERISTICS statement (that may itself have been implicitly invoked by the FMTRANSPORT statement).

[atk] - Parameter 6 is optional. It specifies the actual starting track address for this partition. The presence of this parameter overrides the procedure outlined in Parameter 3 (ntk) for the automatic generation of the starting track address. This parameter would normally be present only when it is desirable that two or more partitions share some or all of their respective space on the transport.

[xutsk]
[-infl] - Parameter 7 is optional. It specifies either a task name or a negative influence limit. If a task name is given, the designated task is given permanent exclusive use of the device to the complete exclusion of all other tasks.

If a negative influence limit number in the range of -000 to -255 is given, then only tasks that have an influence limit number that is less than or equal to this parameter are permitted to use this logical device. The default is an influence limit number of -255.

[WOR]
[NOW] - Parameter 8 is optional. It specifies whether an End-of-Record (EOR) mark is to be written on the last sector for every write operation performed on this transport. If the keyword WOR is given, then an EOR will be written. If the keyword NOW is given, then an EOR will not be written. Once EOR marks have been written, then a read operation will "not" input a larger block than that which was written. The EOR marks are generally used only when Parameter 5 specifies an unlimited (and therefore variable) record size and the routine reading wishes to use the hardware EOR detection capability to delimit the record size. The default is NOW.

Use of the DISCDEVICE statement generates an assembly symbol of STKxxx where xxx is the DISCDEVICE dname. This symbol can be used as the "atk" parameter when defining overlapping partitions in that STKxxx is SET to the starting track number for partition xxx.

7.5.5 SYSGEN STATEMENT EXAMPLES

```
COMCONTROLLER  AF0,#18,000,TIMED,,,K,,,,EVEN,9600
      .
      .
      .
FMTRANSPORT    AP0,0,AF0,,,,,,,2
      .
      .
      .
LOGTRANSPORT A00,AP0,0,77,NOF
      .
      .
      .
DISCDEVICE     AM1,A00,77,1,0,,,WOR
      .
      .
      .
```

7.6 COMMUNICATIONS PROCESSOR USAGE

If the user has asked to utilize the Direct Memory Interface and the Communications Processor (CP) is either not available in the system configuration or there is no physical connection between the CP and the controller, then the handler will automatically alter its control tables (PDT) to reflect the actual/operational interface to the physical device in question. The Data Interrupt (DI) mode of operation will be utilized in such cases as a replacement. As far as the user is concerned, only a slight performance difference is noted when referring to the overall timing involved in a user transfer request.

PROGRAMMER'S ERROR BIT IN UFT WORD UFTSTA	OPERATOR'S REASON CODE	REASON FOR COMMUNICATIONS ERROR IF SET
0	ER	SOME ERROR EXISTS
1	OVF	INPUT CHANNEL OVERRUN ERROR
2	PAR	INPUT CHANNEL PARITY ERROR
3	INO	-DEVICE DOES NOT EXIST OR DOES NOT RESPOND. -DEVICE INOPERABLE. -WATCHDOG TIMER HAS EXPIRED.
4	MPE	MEMORY PARITY ERROR WAS DETECTED WHILE THE DIRECT MEMORY INTERFACE (DMI) WAS TRANSMITTING DATA TO/FROM MEMORY.
5	LOK	-INPUT AND/OR OUTPUT CHANNEL MALFUNCTION ERROR. -CPU/AFD SYNCHRONIZATION PROBLEM.
6	CIG	INPUT CHANNEL FRAMING ERROR.
7	OTH	-USER SPECIFIED TERMINATE REQUEST. -OPERATION ERROR UNDER LOCAL ERROR RECOVERY WHERE THE ERROR REASON CODES HAVE BEEN PLACED IN UFT WORDS UFTBCT AND UFTFAT.
8	SBV	LOGICAL ERROR - THE FINAL TRANSFER BYTE COUNT IS NOT EQUAL TO THE REQUESTED TRANSFER COUNT
9	EOM END-OF-MEDIUM	SET WHEN LAST SECTOR OF PARTITION IS ACCESSED.
10	EOF END-OF-FILE	-SET AFTER WEOF, REWIND, OR HOME OPERATION. -SET WHEN A FILE MARK SECTOR IS ACCESSED BY READ, ADVANCE, OR BACKSPACE OPERATION. -SET WHEN BACKSPACE OPERATION IS ATTEMPTED WHILE CURRENTLY POSITIONED AT THE BEGINNING OF A DISC PARTITION.
11	BOM BEGINNING-OF-MEDIUM	-SET AFTER REWIND OR HOME OPERATION. -SET WHEN BACKSPACE FILE OR RECORD BACKSPACES TO THE BEGINNING OF THE DISC PARTITION. -SET WHEN A READ OPERATION DETECTS AN END-OF-RECORD MARKER.

Table 7-1. Asynchronous Floppy Disc Communications Errors and Events

PROGRAMMER'S ERROR/ STATE BIT IN UFT WORD UFTBCT	REASON FOR AFD ERROR/STATE IF SET
0	NOT USED
1	CPU TRANSMITTED MORE DATA THAN ORIGINALLY SPECIFIED IN THE TC (TRANSFER COUNT) PARAMETER OF THE SST-WRITE COMMAND.
2	AFD DETECTED A CRC ERROR.
3	SELECTED DRIVE IS INOPERABLE.
4	AFD REJECTED CPU COMMAND.
5	WRITE OPERATION ATTEMPTED TO A PROTECTED DISKETTE.
6	SEEK ERROR.
7	AFD IS BUSY.
8	AFD IS IN MAINTENANCE MODE.
9	NOT USED.
10	NOT USED.
11	NOT USED.
12	SELECTED DRIVE IS SEEKING.
13	AFD UNABLE TO FIND REQUESTED SECTOR.
14	AFD CHANNEL ERROR, ONE OF THE FOLLOWING: o MALFUNCTION ERROR. o SYNCHRONIZATION ERROR. o PARITY ERROR. o FRAMING ERROR. o OVERRUN ERROR.
15	UNIT NUMBER.

Table 7-2. Asynchronous Floppy Disc Device Errors and Events

CHAPTER 8
MAX IV LOCAL PROCESS I/O HANDLERS (Models 1300, 11xx)

The MAX IV Process Control Input/Output (PIO) device handlers extend the MAX IV Basic I/O System (BIOS) to allow access to the MODCOMP Wide Range Solid State Analog Input Subsystem (WRSSAIS) model number 1300-1 and Input/Output Interface Subsystem model number 11xx. The MAX IV PIO handlers do not attempt to implement all of the device independent modes utilized by many of the non-PIO handlers since PIO devices are so functionally different.

The MAX IV PIO handlers support the following REX I/O calls: READ, WRITE, and TERMINATE. All other control services (REWIND, BACKSPACE...HOME) are treated as No-Operations.

MAX III compatibility is fully maintained by the MAX IV PIO handlers with the exception of data chaining. The MODCOMP CLASSIC string chaining method is the only one supported by the hardware and the PIO software. Any task making a III compatible call with data chaining specified will be aborted with the reason code: "III CHN".

8.1 PIO UFT EXTENSION

The PIO handlers require two additional words in front of the standard (MAX III or IV) User File Table (UFT). These two words are necessary in order to pass the address of a Scan Table and the Number of Points and zero-suppression words in the Scan Table to the handlers.

The user still loads the address of word zero of the UFT into Register 2 for the REX services; the two additional words should be addressed as "UFT-1" and "UFT-2".

The essential elements of the PIO UFT as implemented under MAX III and as supported under MAX IV are specified in Figure 8-1.

NOTE: Handler support for MODACS interfaces is provided with the MODACS Software Subsystem, Model 8844. Information about these handlers is contained in the following manuals:

MODACS III - MODULAR DATA ACQUISITION AND CONTROL SUBSYSTEM III, Programmer's Reference Manual

MODACS II - MODULAR DATA ACQUISITION AND CONTROL SUBSYSTEM II, Programmer's Reference Manual

WORD	DESCRIPTION
-2	Scan Table Address for random mode or Starting Channel Number for sequential mode operations.
-1	Number of words in Scan Table (including zero-suppression words) for random mode or Number of Channels for sequential mode operations.
Ø	Standard UFT Status.
1	Standard UFT File Name.
2	Formats and Options. The following bits are recognized:

BIT	NAME	DESCRIPTION
Ø	SR	System Recovery (Standard)
5	RA	Random Mode (Standard)
7	RNQ	Return if Not Queued (Standard)
14	CHN	Data Chaining (NOT SUPPORTED)
15	CYC	Cyclic Mode request (PIO only)

3	Standard Device Position Index. In random mode, however, this word has no meaning and is simply incremented.
4	Standard UFT Byte Count.
5	Standard Assign List Pointer.

Figure 8-1. MAX III Compatible PIO UFT

The MAX IV PIO UFT conforms to the standard MAX IV UFT except for the maintenance of the two word extension as implemented under MAX III. Figure 8-2 describes the essential elements of the MAX IV PIO UFT.

WORD	DESCRIPTION
-2	Scan Table Address for random mode or Starting Channel Number for sequential mode operations/Chain List Address.
-1	Number of Words in Scan Table (including zero-suppression words) for random mode or Number of Channels for sequential mode operations/Map Select for Data Chaining.
Ø	Standard UFT Status.
1	Standard UFT File Name.
2	Formats and Options. The following bits are recognized:

BIT	NAME	DESCRIPTION
Ø	SR	System Recovery (Standard)
5	RA	Random Mode (Standard)
7	RNQ	Return if Not Queued (Standard)

3	Standard Device Position Index. In random mode this word has no meaning and is simply incremented.
4	Standard UFT Byte Count.
5	Standard Assign List Pointer.
6	Standard Extended User's Option with one additional bit:

BIT	NAME	DESCRIPTION
9	CYCL	Cyclic mode operation request.

7	Standard MIAP.
8	Standard Buffer/Chain List Address.
9	Standard Byte Count/Map Select for Data Chaining.

Figure 8-2. MAX IV PIO UFT

8.2 MAX IV PIO DATA CHAINING

Data chaining may be specified for all MAX IV PIO calls to "interrupt driven" handlers ("immediate" handlers do not permit data chaining); if the device does not have a DMP, data chaining is simulated.

Data chaining is specified in the standard manner as described in MAX IV Basic I/O System, System Guide Manual. Since PIO devices require two buffers, in some cases, data chaining may be specified for the scan table and/or the I/O buffer.

The words at UFT-2 and UFT-1 are analogous to the buffer address and byte count, respectively, and may be entered as a chain list address and map selection indicator if data chaining of the scan table is required.

It should be noted that data chaining for the buffer address and byte count fields may be specified even if the operation is specified as sequential.

8.3 CYCLIC OPERATIONS

The cyclic mode of operation provides a method of continuous sampling of analog input values until the operation is terminated with a TERMINATE REX call.

Cyclic operations should be requested in the quick return mode. If they are not, the calling task will not be resumed until another task or the system operator terminates the operation.

8.4 IMMEDIATE HANDLERS

The analog input handlers are of the conventional type in that each requested operation is queued by the Logical I/O System. Requests to immediate process devices (analog output, digital output, and digital input) are processed by handlers that operate entirely at the calling task level. These requests are not queued but are processed immediately. Data chaining and Cyclic mode operations are not permitted with the immediate handlers; any task attempting these modes of operation will be aborted with the reason code: "PIO MOD".

8.5 HANDLER DESCRIPTIONS

8.5.1 WIDE-RANGE SOLID-STATE (WS) ANALOG INPUT HANDLER

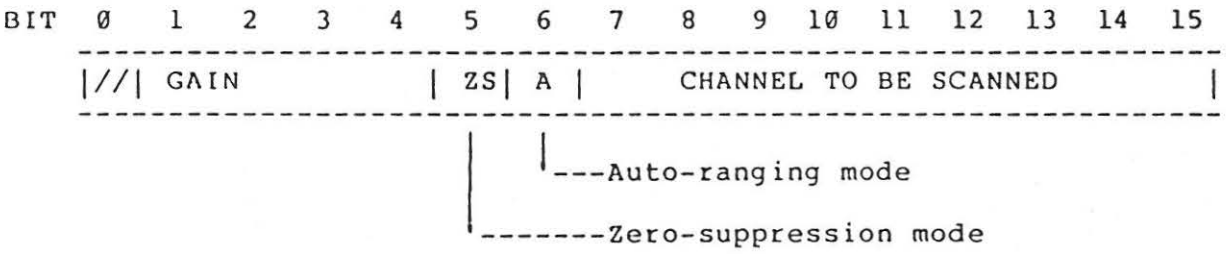
The Wide-Range Solid-State Analog Input handler interfaces with the Wide-Range Solid-State Analog Input Subsystem, Model 1300-1. This device is of the dual-control section type. That is, there is a separate control section for input of the digitized analog data and a section for output of the scan table (see the CONTROLLER SYSGEN statement). This device has extremely fast data transfer rates and must be available with two Direct Memory Processors (DMP). The Wide-Range Solid-State (WS) uses DMP #6 for input and DMP #5 for output.

WS is the designated controller name for the subsystem. The group/unit numbers for WS are #13 for input and #12 for output.

The Wide-Range Solid-State device cannot be addressed in the sequential mode. Any attempt to do so will result in the task being aborted with the reason code "PIO MOD" for system error recovery; the OTH error bit in the UFT will be set for local error recovery.

The Wide-Range Solid-State device may require one or two output words to select each channel. Refer to Figure 8-3 for the channel select format.

WORD 1



WORD 2 (optional)

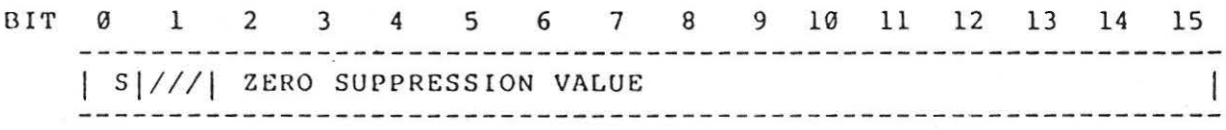


Figure 8-3. WRSS Output Format Channel Select

Bits 7-15 of Word 1 define the channel number to be scanned. A maximum of 512 different channel numbers may be specified. The WS device accepts voltage inputs in 12 different ranges varying from + or -5 millivolts to + or -10.24 volts.

The desired range or gain is specified in Bits 1-4 of Word 1 (hexadecimal range 0 to B). Table 8-1 shows the voltage range obtained by each available gain and the scale factor required to convert the input data to millivolts.

GAIN	CONVERSION SCALE FACTOR (SF)	FULL SCALE INPUT (MILLIVOLTS)
0	.00244140625	+ or -2048xSF = + or -5
1	.0048828125	+ or -2048xSF = + or -10
2	.009765625	+ or -2048xSF = + or -20
3	.01953125	+ or -2048xSF = + or -40
4	.0390625	+ or -2048xSF = + or -80
5	.078125	+ or -2048xSF = + or -160
6	.15625	+ or -2048xSF = + or -320
7	.3125	+ or -2048xSF = + or -640
8	.625	+ or -2048xSF = + or -1280
9	1.25	+ or -2048xSF = + or -2560
A	2.5	+ or -2048xSF = + or -5120
B	5	+ or -2048xSF = + or -10240

Table 8-1. Voltage Ranges

Bit 6 of Word 1, if set, specifies that the auto-ranging mode of the device is to be utilized. In this mode the device automatically selects the appropriate gain required to provide the best resolution of the input data. In this case, Bits 1-4 are ignored and the selected gain is returned as part of the input data.

Bit 5 of Word 1, if set, specifies that the zero-Suppression mode of the device is to be utilized. In this mode it is necessary to specify the zero-suppression value in Word 2. Zero-suppression allows the user to measure the variation of an input voltage with greater accuracy. The zero-suppression value is subtracted from the measured input voltage by the device hardware. This allows a higher gain to be specified, thereby providing greater accuracy.

For example, it is required to measure an input voltage of 8 volts + or -2 millivolts. Without zero-suppression a gain value of hexadecimal #B (range + or -10.24 volts) must be specified. With this gain a resolution of 5 millivolts per bit can be attained. Therefore, it is not possible to measure the + or -2 millivolt variation in the input voltage. However, if a zero-suppression value of 8 volts (hexadecimal 3200) is specified, a gain value of hexadecimal 8 may be used. Note that the zero-suppression value must be scaled by the selected gain. This provides a resolution of 0.625 millivolts per bit which is sufficient in this example to measure the + or -2 millivolt variation.

Once the voltage has been input, the zero-suppression value must be added back by the user to obtain the actual input voltage. This provides a 15-bit value plus sign.

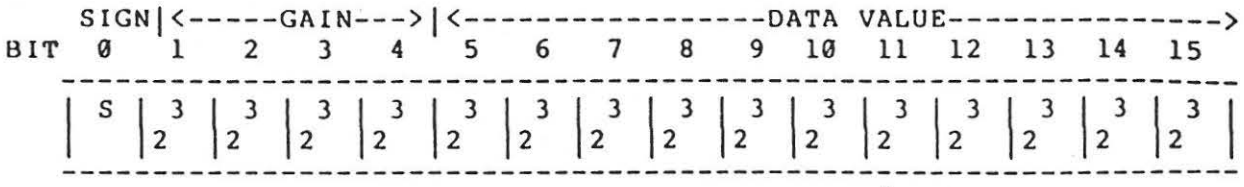


Figure 8-4. WRSS Input Data Format

To read the analog input data, the handler does a DMP write of the scan table with the specified channel addresses followed by a DMP read for the data values. If zero suppression is specified, an additional zero suppression value must be added to the scan table for each channel where it is specified.

The size differential between the number of words in the scan table to be written and the number of data values to be read is determined by separately specifying the scan table size and the number of channels that are to be addressed. The number of words in the scan table is specified in UFT-1. The UFT byte count that is specified in the REX read to the handler determines the number of channels being addressed.

Data chaining or cyclic operations may also be specified.

8.5.2 IOIS (IO) ANALOG OUTPUT HANDLER

This handler is designed to interface with the analog output modules of the Input/Output Interface Subsystem (Model 1100). IO is an immediate handlers in that it is not interrupt driven and operates directly at the calling task level. This means that the operation is not queued but is performed immediately prior to returning to the calling task. The concept of Wait or Quick-Return mode thus loses its meaning. All output requests are performed in the random mode and data chaining or cyclic operations cannot be specified.

The designated controller name for the IOIS analog output device is IO. The group/unit number for this device lies in the range #20-#2B or #30-#3B.

When a base group/unit number has been chosen, the channel addresses and I/O group numbers specified in the channel select words (scan table) are added to this base group/unit number. This provides the capability to treat a group of IOIS addresses as a single device. Care must be taken to ensure that the combination of the base group/unit and the number in the scan table format add up to a legitimate value. If the resultant group/unit is less than the base group/unit, an error is indicated and the task is aborted with the reason code "PIO GU " for system error recovery; the OTH error bit in the UFT will be set for local error recovery. If desired, several controllers (IO, IO1, ... IO7) can be designated to point to sets of IOIS channels.

The IOIS analog output format (for example, scan table format) requires one word to select each channel. This word has two types of formats. Refer to Figure 8-5 for a description of each format.

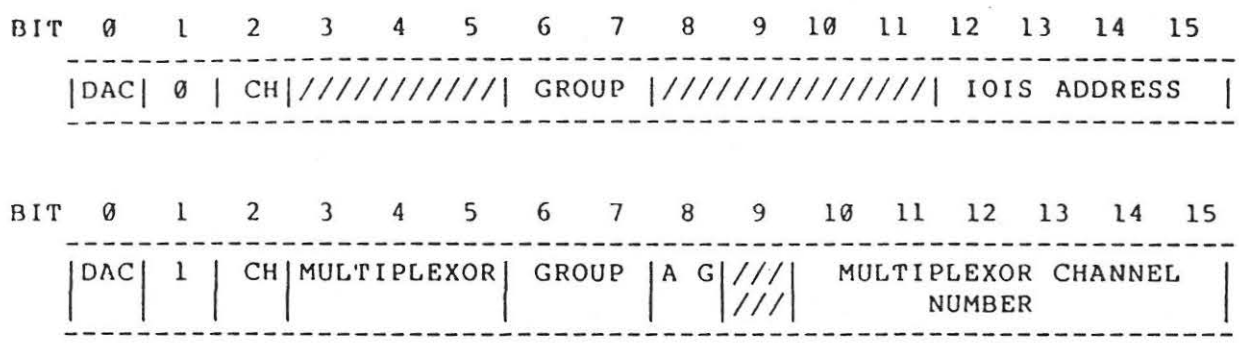

BIT 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
DAC 0 CH GROUP IOIS ADDRESS
BIT 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
DAC 1 CH MULTIPLEXOR GROUP A G MULTIPLEXOR CHANNEL NUMBER

Figure 8-5. IOIS Analog Output Format Channel Select

Bit 1 set to zero designates the word as type 1 format and Bit 1 set to one designates it as type 2 format.

The type 1 format directly specifies an I/O group and IOIS channel address relative to the base group/unit. Bits 12-15 define the relative IOIS channel address. Bits 6-7 define the relative I/O group. Note that although the group field allows specification of all four I/O groups, only groups C and D are normally used for IOIS.

Bit 0 defines the type of DAC. Bit 0 set to zero defines a voltage DAC and set to one defines a current DAC.

Bit 2 selects the channel of a dual DAC. Bit 2 set to zero selects channel 0 and set to one selects channel 1.

The type 2 format allows the user to select a DAC on a multiplexed channel. The multiplexor Channel Module on the IOIS allows interfacing of up to four Expander Chassis each with 16-channel capability, or up to 64 channels per multiplexor. A maximum of 16 Multiplexor Channel Modules is allowed.

Bits 3-5 (in conjunction with Bit 8) of the type 2 format specify the IOIS channel address on which the Multiplexor Module is located. The bit translation is shown in Table 8-2.

Multiplexor Address (Bits 3-5)	Multiplexor Augmenter (Bit 8)	IOIS Channel Address
000	0	#F
001	0	#E
010	0	#D
011	0	#C
100	0	#B
101	0	#A
110	0	#9
111	0	#8
000	1	#7
001	1	#6
010	1	#5
011	1	#4
100	1	#3
101	1	#2
110	1	#1
111	1	#0

Table 8-2. IOIS Channel Address

Normally, the Multiplexor Module is on IOIS channel 15 and therefore, in most cases, the multiplexor address is zero. Bits 10-15 of the type 2 format define the channel number on the multiplexor, 0 through 63.

The output data format required for analog output is merely a signed integer value. The handler converts this to an 11-bit plus sign value for output to a voltage DAC and to a 12-bit value (always positive) for output to a current DAC. Refer to Figure 8-6.

BIT	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	S	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}

Figure 8-6. IOIS Analog Output Data Format

8.5.3 IOIS (ID) DIGITAL INPUT/OUTPUT HANDLER

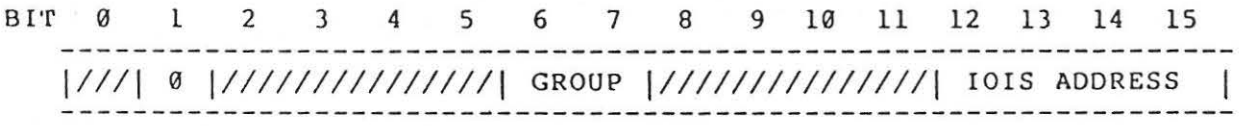
This handler interfaces with the digital output modules provided by the IOIS. It allows the output of 16-bit digital words to the external device or the input of the external digital words. The handler is of the immediate type. Therefore, the operation is not queued but is performed immediately prior to returning to the calling task. All requests are performed in the random mode and data chaining and cyclic operations cannot be specified.

The designated controller name for the IOIS digital input/output module is ID. The group/unit number for this device lies in the range of #20-#2F or #30-#3F.

When a base group/unit number has been chosen, the channel addresses and I/O group numbers specified in the channel select words (scan table) are added to the base group/unit number. This provides the capability to treat a group of IOIS device addresses as a single device. Care must be taken to ensure that the combination of the base group/unit and the number in the scan table add up to a legitimate value. If the resultant group/unit is less than the base group/unit, the task will be aborted with the reason code "PIO GU" for system error recovery; the OTH error bit in the UFT will be set for local error recovery. If desired, it is possible to designate several controllers (ID, ID1, ..., IDF) to point to sets of IOIS controllers on one computer system; two or three are the maximum allowed.

The digital output format (for example, scan table format) requires one word to select each channel. For the IOIS there are two types of formats. These formats are shown in Figure 8-7.

Type 1



Type 2

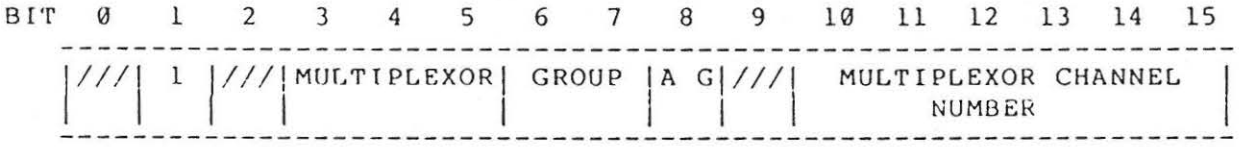


Figure 8-7. IOIS Digital Output Format Channel Select

Bit 1 set to zero designates the word as type 1 format and Bit 1 set to one designates it as type 2 format.

The type 1 format directly specifies an I/O group and IOIS channel address relative to the base group/unit. Bits 12-15 define the relative IOIS channel address. Bits 6-7 define the relative I/O group. Although the group field allows specification of all four I/O groups, only groups C and D are normally used for IOIS.

The type 2 format allows the user to select a digital input or output word in a multiplexed channel. The Multiplexed Channel Module on the IOIS allows interfacing of up to four Expander Chassis each with 16-channel capability, or up to 64 channels. A maximum of 16 multiplexors may be specified.

Bits 3-5 (in conjunction with Bit 8) of the type 2 format word specify the IOIS channel address on which the Multiplexor Module is located. The bit translation is shown in Table 8-2.

Normally, the Multiplexor Module is on IOIS channel 15 and therefore, in most cases, the multiplexor address is zero. Bits 10-15 of the type 2 format define the channel number on the multiplexor, 0 through 63.

8.6 PIO ERROR MESSAGES

The handlers output holdup and abort messages to the operator. The Abort message is shown in Figure 8-8.

ABORT CODES YYY AND ZZZ : !ABORT (YYY ZZZ #hhhh) /tttttt/oooooo	
"PIO MOD"	AN INCORRECT MODE OF OPERATION WAS ATTEMPTED ON A PIO DEVICE.
"III CHN"	A MAX III/IV COMPATIBLE CALL WAS MADE SPECIFYING DATA CHAINING.
"PIO GU "	THE GROUP/UNIT CALCULATION INVOLVED WITH THE IO or ID HANDLER PRODUCED AN INVALID RESULT.

Figure 8-8. PIO Abort Messages

A message reporting a holdup condition is output to the operator in the following format:

```
!ddn?/tttttt/oooooo
```

Where:

ddn - is the device name

tttttt - is the calling task's name

oooooo - is the current task overlay name

This message reports the following conditions:

- o device under exclusive use by another task.
- o device already offline. Operator has not reported.

8.7 SYSTEM GENERATION

The Process I/O (PIO) handlers may be included in the I/O Structure Block in much the same manner as standard system devices. At least two system generation statements are required to define a particular PIO device configuration to the system. These statements are CONTROLLER and DEVICE, and are identical to those described in the MAX IV SYSGEN, System Guide Manual. The standard CONTROLLER statement has provisions for specifying the dual control sections of the WS handler (gu2 and dmp2). These statements produce the required interrupt linkages, data tables, and handler calls that cause the appropriate PIO handlers to be included in the system.

8.7.1 CONTROLLER STATEMENT

The CONTROLLER statement defines the unique hardware data path used by a device and not the device itself. The statement causes a data interrupt and a service interrupt linkage to be generated with a data table called the Physical Device Table.

SYNTAX

```
                    1   2    3      4      5     6
     CONTROLLER     hhx,#gu[,dmp][,TIMED][,gu2][,dmp2]
```

hhx - Parameter 1 must be a unique name for each controller statement. This name must be chosen in a special way so that it selects the particular device handler to be included in the I/O system. This is accomplished by making the first two characters of the 3-character name (shown as "hh") equivalent to the name of a PIO device. The third character of the name, "x", can be any valid alphanumeric character (., $, :); its purpose is to ensure uniqueness in defining the names of all devices that share the handler. The names of the available PIO devices are shown in Table 8-3.

#gu - Parameter 2 defines the CLASSIC group (g) and unit (u) that are unique to the hardware controller. These group/unit numbers are concatenated into one hexadecimal number. The group/unit numbers most commonly used for PIO device controllers are shown in Table 8-3.

[dmp] - Parameter 2 is included only if the particular device controller requires a Direct Memory Processor (DMP) channel for input. The most commonly used DMP numbers are shown in Table 8-3. If this parameter is not included, a null parameter must be included if it is to be followed by the remaining parameters. A null parameter consists of two contiguous commas (,,).

[TIMED] - Parameter 4 is a keyword included only if the particular device should have a watchdog timer set each time an operation is initiated on the controller. If included, the timer controller table (PDT) is linked into a special timer queue maintained by the real-time clock. It is suggested that all analog input devices be timed.

[gu2] - Parameter 5 is required for those devices requiring a dual-control section. It specifies the group/unit to be used for the output side of the controller as described in the Table 8-3.

[dmp2] - Parameter 6 is required for those devices requiring a second DMP for the output side of their dual-control section (see Table 8-3).

DEVICE TYPE	HANDLER NAME (hh)	INPUT GROUP/UNIT #(gu)	INPUT DMP (dmp)	OUTPUT GROUP/UNIT #(gu2)	OUTPUT DMP #(dmp2)	WATCHDOG*
Wide Range Solid State Analog Input - (Model 1300)	WS	#13	#6	#12	#5	-128
IOIS Analog Output, Digital Input/Output (Model 1100)	ID IO	#20 or #30	--	---	--	---

* Watchdog counts are in basic clock resolution (5.00 msec.). if the count is exceeded, the device is set INOPERABLE.

Table 8-3. PIO Handler Names/Groups/Units/DMPs/Times

8.7.2 DEVICE STATEMENT

The DEVICE statement is required to define each logical PIO device that is required in the system configuration. These logical devices are linked to the hardware controllers that were specified in the CONTROLLER statement. Refer to Table 8-4.

SYNTAX

```
                    1   2    3     4          5              6
     DEVICE      ddn,hhx[,bpr][,dop][,exclutask ][,watchdog]
                                    [,-influence]
```

ddn - Parameter 1 is the 1-3 character device name that must be unique to all non-disc devices. The first two characters are identical (for PIO devices) to the CONTROLLER name and the third character (n) allows unique devices of a given type to be defined.

hhx - Parameter 2 is the name of the CONTROLLER to which this device belongs.

bpr - Parameter 3 is the natural block size (bytes per record) of the device. The default value, when not specified, is dependent upon the device type as determined by the first two characters of the name.

dop - Parameter 4 permits modification of the contents of a word in the data structure entry for this device. It is not necessary, and, in fact undesirable, to enter this parameter. The value is automatically supplied when omitted.

[exclutask]
[-influence] - Parameter 5 is optional. It specifies either a task name or a negative influence limit. If a task name is given, the designated task is given permanent exclusive use of the device to the complete exclusion of all other tasks.

If a negative influence limit number in the range of -000 or -255 is given, then only tasks that have an influence limit number with absolute value less than or equal to the absolute value of this parameter are permitted to use this logical device. The default is a negative influence limit number of -255.

watchdog - Parameter 6 is the maximum time (in basic clock interrupt periods) that an operation is allowed to stay at the head of the I/O queue of its controller. If not specified, an appropriate default value is assigned.

DEVICE TYPE	DEVICE NAME (ddn)	CONTROLLER NAME (hhx)	RECORD LENGTH (bpr)	DEVICE OPTION (dop)
Wide Range Solid State Analog Input (Model 1300)	WSn	WSx	0	#8480
IOIS Analog Output (Model 1100)	IOn	IOx	0	#0080
IOIS Digital (Model 1100)	IDn	IDx	0	#4080

Table 8-4. PIO Logical Devices

8.7.3 EXAMPLE PIO HANDLER SYSTEM GENERATION

The following statements, if included in the standard system generation procedures, cause all the previously described handlers to be included in the system. Please note that these statements do not produce a MAX IV system but are only the additional statements required to include the PIO handlers. For a complete description of a MAX IV system generation, refer to the MAX IV SYSGEN, System Guide Manual.

If the FORTRAN digital input/output latching subroutines are to be utilized by the generated system, a global common area might also be required in the system generation. These latching subroutines allow the digital input/output handlers to set or reset individual bits in a bit string. The current state of the bits may be kept in global common. Refer to the MAX IV SYSGEN, System Guide Manual.

```
*       ASSUME PIOP.
        CONTROLLER WS,#13,#6,TIMED,#12,#5   WIDE RANGE SOLID STATE ANALOG
*       FOLLOWING ARE NON-INTERRUPT DRIVEN.
        CONTROLLER IO,#30                   I/OIS ANALOG OUTPUT
        CONTROLLER ID,#30                   I/OIS DIGITAL I/O
*       DEVICES -- 1ST 2 CHS. SAME AS CONTROLLER NAME.
        DEVICE     WS,WS
        DEVICE     IO,IO
        DEVICE     ID,ID
```

	ASCII MODES		BINARY MODES	
	STANDARD	NON-STANDARD	STANDARD	NON-STANDARD
0 READ	READ FIXED LENGTH RECORD INTO BUFFER AS DESCRIBED BY SCAN TABLE			
1 WRITE	WRITE FIXED LENGTH RECORD INTO BUFFER AS DESCRIBED BY SCAN TABLE			
2 REWIND	null+			
3 BKFILE	null+			
4 BKRECORD	null+			
5 AVRECORD	null+			
6 AVFILE	null+			
7 WEOF	null+			
8 HOME	null+			

+ This operation sets EOF and BOM event bits in UFT status word.

Table 8-5. PIO Operations and Modes

PROGRAMMER'S ERROR BIT IN UFT WORD UFTSTA	OPERATOR'S REASON CODE	REASON FOR ERROR IF SET
1	OVF OVERFLOW/ UNDERFLOW	-NONE-
2	PAR PARITY OR DATA CHECK	-NONE-
3	INO INOPERABLE	THE WATCHDOG TIMER EXPIRED AFTER OPERATION INITIATION WITHOUT A DATA INTERRUPT.
4	MPE MEMORY PARITY OR IOP ERROR	-NONE-
5	LOK WRITE LOCK	-NONE-
6	CIG CHARACTER IN GAP	-NONE-
7	OTH OTHER	SEE THE INDIVIDUAL HANDLERS FOR THE MEANING OF THIS BIT.
8	SBV STANDARD BINARY VIOLATION	-NONE-
9	EOM END-OF-MEDUIM	-NONE-
10	EOF END-OF-FILE	SET FOR null OPERATION.
11	BOM BEGINNING- OF-MEDIUM	SET FOR null OPERATIONS.

Table 8-6. PIO Errors and Events

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